The Effects of a Large-Scale Mental-Health Reform: Evidence from Brazil

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Abstract

This paper studies the Brazilian psychiatric reform, which reorganized mental healthcare provision by the public system building a network of community-based services centered on the Psychosocial Care Centers (CAPS). Our research design exploits the rollout of CAPS in a differences-in-differences framework. We show that these centers improved outpatient mental healthcare utilization and reduced hospital admissions due to mental and behavioral disorders. Those reductions were more pronounced for long-stay admissions and among patients with schizophrenia. Additionally, centers delivering substance abuse treatment reduced deaths caused by alcoholic liver disease. Despite these positive effects, we also find that the shift away from inpatient care increased homicides.

1 Introduction

Mental and addictive disorders affected more than 1 billion people globally in 2016, being considered one of the most burdensome non-communicable diseases in the world (Rehm and Shield, 2019). People with major depression and schizophrenia have a 40% to 60% greater chance of dying prematurely than general population. Besides that, suicide is the second most common cause of death among young people worldwide (WHO, 2013). The absence of mental health may also have devastating effects on an individual's ability to lead a balanced professional, social and family life (Roy and Schurer, 2013; Frijters et al., 2014; Kessler et al., 1998). The economic consequences of these are equally large. Estimates suggest that the global impact of mental disorders in terms of lost economic output for the period 2011-2030 will amount US$ 16.3 trillion (Bloom et al., 2012). Yet, health systems have not adequately responded to the burden of mental health disorders. The gap between the need for treatment and its provision is large all over the world. In low and middle income countries, between 76% and 85% of people with severe mental illness do not receive treatment for their disorder. The corresponding range for high income countries is also high: between 35% and 50% (WHO, 2013).

The numbers indicate that a better provision of mental health care might significantly improve a given population's well-being. It is not obvious, though, how to optimally provide this type of care. In the second half of the twentieth century, many countries started to switch from a model of mental health care centered on psychiatric hospitals toward a model based on community care. However, international experience shows that this process is not something simple to be done. Reducing hospital admissions without offering adequate community-based care with proper integration to other medical services may not only fail to

improve the delivery of mental health care services, but also generate undesirable consequences (Sisti et al., 2015; Rosenbaum, 2016; Lamb, 2015).[1] Hence, it is important to understand how different strategies to implement community-based mental health care work and how deinstitutionalization can be done while avoiding the potential pitfalls associated with it.

Despite this significant change in philosophy and its importance, there is little rigorous research measuring the effects of policies directed toward the effective provision of community-based mental healthcare. This paper investigates this question by examining the psychiatric reform in Brazil. The Brazilian reform was centered on the introduction of Psychosocial Care Centers (*Centros de Atenção Psicossocial* – henceforth, CAPS) as a community-based substitute for inpatient care for people with moderate or severe mental disorders. More specifically, CAPS provide a number of outpatient procedures such as medical consultations, individual and group therapy, and therapeutic workshops. Also, CAPS, as part of the national healthcare system (*Sistema Único de Saúde* – SUS), work as gateways to the mental health care system and, if adequate care cannot be provided there, the person can be referred to the adequate facility. Hence, to study the psychiatric reform, we focus on the effects of introducing a CAPS in a municipality. In particular, we assess the CAPS' effects on density of mental health professionals, on utilization of outpatient mental healthcare, and on deaths and hospital admissions by cause. Among causes, we investigate mental and behavior disorders, suicide, alcoholic liver disease, and overdose.

We additionally study the reform's effect on homicides. A recurrent concern about deinstitutionalization – the process of reducing men-

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[1]This idea is often connected with the concept of transinstitutionalization: when individuals are released from psychiatric institutions and no adequate option is offered, they may migrate to other institutions, usually part of the correctional system.

tal hospitalization and providing community-based alternative services (Lamb and Bachrach, 2001) – is with increased violence. There is extensive evidence that severe mental illness is closely associated with an increased risk of aggressive behavior, crime and victimization (Hodgins et al., 1998; Rueve and Welton, 2008; Fazel et al., 2009; Teplin et al., 2005). Historically, there has been a debate about criminality and inpatient versus community-based mental healthcare. For example, in the 70's, when community services started to expand in the U.S., people fearing an increase in crime in their community made so much opposition that several new psychiatric centers had to be closed (Rabkin, 1979). A few specialists share a similar concern by advocating that community care is not suited for all mentally ill persons, especially those at risk of becoming criminalized (Lamb and Weinberger, 2005). Contrary, others defend that this type of care can be successful in such cases, provided that adequate community treatment resources are available (Slate et al., 2013). Empirically, this is still an open question.

Our empirical strategy exploits the roll-out of CAPS across the the Brazilian municipalities in a differences-in-differences framework. Following De Chaisemartin and d'Haultfoeuille (2020), we use a DID estimator that is robust to heterogeneous treatment effects across cohorts and over time. Parallel pre-trends for the set of outcomes we evaluate provide evidence on the design validity. We first document that the introduction of CAPS increased access and utilization of community-based mental health care. More specifically, the implementation of these centers was associated with immediate and large increases in the density of mental health professionals, as well as in outpatient visits made by them. Consistent with these results, we also found an increase in the number of drugs dispensed in outpatient care for the treatment of psychiatric disorders. Turning to morbidity and mortality outcomes, we find that

CAPS decreased hospital admissions due to mental illness. The effects are driven by the reduction of long-stay hospitalizations of individuals with schizophrenia. Additionally, centers specialized in substance abuse treatment reduced deaths due to alcoholic cirrhosis. Despite these positive effects, we also find a persistent increase in homicide rates, potentially caused by the CAPS' effects on mental hospital admissions. We confirm that this increase in homicide rates does not seem to be due to a general increase in crime potentially correlated with the introduction of CAPS (as measured by robberies and thefts).

This paper contributes to the rich economic literature on mental health. Many papers study different determinants of mental health, as medication (Dalsgaard et al., 2014; Ludwig et al., 2009), early life conditions (Persson and Rossin-Slater, 2016; Almond and Mazumder, 2011; Adhvaryu et al., 2019), economic shocks (Ruhm, 2000; Schwandt, 2018), and income shocks (Christian et al., 2019; Baird et al., 2013). A recent set of experimental papers evaluate the effects of psychological interventions on mental health or related outcomes (Baranov et al., 2020a,b). Finding evidence of government policies that impact mental health, however, is a much harder task. A few papers study policies that look at some measure of mental health as a secondary outcome, like Katz et al. (2001) on the Moving to Opportunity program or Milligan and Stabile (2011) on child tax benefit expansions. We are not aware, though, of any paper that studies a large scale public policy targeted specifically at mental health. This paper helps to fill this gap.

Despite being one of the first studies to study the effects of community-based mental healthcare, we are well aware that the question of whether this type of care is effective is not new to the public health and medical literature (Wiley-Exley, 2007). Community-based mental health services has been linked negatively to mental hospitalizations (Wanchek et al.,

2011; Madianos and Economou, 1999), suicide rates (Pirkola et al., 2009; While et al., 2012), and measures capturing symptoms of schizophrenia and bipolar disorders (Chatterjee et al., 2003; Chisholm et al., 2005; Hickling et al., 2001). However, the existing studies do not aim a causal interpretation and many of them use very small samples. To the best of our knowledge, the present study is the first to exploit a quasi-experimental design to investigate the causal effects of the introduction of community-based mental healthcare in large scale.

As we also evaluate centers providing substance abuse treatment, our findings complement evidence by Swensen (2015). Using U.S. data, the author conducted the first nationwide analysis documenting the causal benefits of substance-abuse treatment on mortality. In particular, drug-overdose deaths. Differently, we present evidence for a developing country and study health facilities whose access is fully subsidized. Additionally, we study a context where the prevalence of substance-abuse-related mortality is very different from that observed in the U.S.. Brazil is one of the countries with the lowest overdose death rates in the world (UNODC, 2013). However, it has a high prevalence rate of heavy episodic drinking, one of the most important indicators for acute consequences of alcohol abuse (WHO, 2019).

Our paper also contributes to the literature linking crime and mental health or mental health services. Eighty years ago, before the advent of full-scale deinstitutionalization, Penrose (1939) found a negative correlation between the proportion of people placed in mental hospitals and the proportion held in prison using cross-country data from European countries. Since then, the Penrose' Hypothesis has been a subject of interest and controversy (Lamb, 2015). Using similar data, some papers found similar results (Mundt et al., 2015; Markovitz, 2006; Raphael and Stoll, 2013), while others did not (Large and Nielssen, 2009).

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A more clear pattern has been found by medical researches that use individual-level data from discharged patients. These papers have systematically reported a high prevalence rate of violence among former inpatients in a post-discharge period (e.g., Link et al. (1992), Fleischman et al. (2014)). Most of these papers have focused on cross-sectional comparisons, which might be subject to omitted variable bias that can affect both crimes and in-patient care utilization. The only paper aiming a causal interpretation for the relation between mental hospitalization and crime is Landerso and Fallensen (2020). But, instead of studying discharge, they analyze the event of admission at a psychiatric hospital and find that inpatient admittance reduces criminal behavior through incapacitation. Our paper exploits potentially exogenous changes in severe mental hospital admissions induced by CAPS' introduction to study the relation between dehospitalization and homicides in the presence of alternative, community-based treatment.

The remainder of the paper is organized as follows. Section 2 describes the institutional and conceptual background. Section 3 presents the data sources. Section 4 describes the empirical approach. In Section 5 we present and discuss our main results. Section 6 presents robustness checks. Section 7 concludes.

2 Background

2.1 Institutional Background

Since the mid-20th century, many countries started to shift mental health care away from psychiatric hospitals toward community-based care – in what became known as deinstitutionalization. The rationale behind this change was based on several assumptions: community-based care is

more human than inpatient care, given the miserable condition of people in psychiatric hospitals; community-based care is more adequate than hospital-based care in general; and community-based care is cheaper than care provided by hospitals (Lamb and Bachrach, 2001). This new paradigm also influenced Brazilian psychiatrists, which ultimately led, in 1989, representative Paulo Delgado to present a bill to the Congress proposing the progressive substitution of psychiatric hospitals by other, community-based resources.

The psychiatric reform bill, with some modifications, eventually became a law – Law 10.216, or the Psychiatric Reform Law – in April 2001, having the CAPS as its centerpiece. During this period, some states passed laws in the same spirit and some CAPS and other related services were created (Britto, 2004). However, only after the Psychiatric Reform Law was passed in 2001 and a Regulatory Ordinance was issued by the Ministry of Health in 2002 the construction of CAPS gained traction and started to happen all over the country (BRAZIL. Ministry of Health, 2005).[2] Figure 1 shows the number of municipalities receiving a CAPS by year, from 2002 to 2016. According to the Brazilian Ministry of Health (BRAZIL. Ministry of Health, 2015), about 900 million Brazilian Reais (BRL) were spent with this policy from 2002 to 2014.[3]

The main goal of the Brazilian psychiatric reform was to implement community-based care services for mental health and substance misuse through CAPS while facilitating deinstitutionalization from hospitals. CAPS also became the main gateway to the public mental health system, referring less severe cases to the Basic Healthcare Units and more

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[2]Actually, CAPS existed even before the bill was presented: the first CAPS was created in the city of São Paulo in 1987. However, as already mentioned, the number of CAPS before 2002 is negligible compared to the number of centers that were created after the Psychiatric Reform Law.

[3]Approximately US$ 220 million.

severe cases to public hospitals.[4] The Regulatory Ordinance of 2002 defined six different CAPS' types, based on municipality size and target population. The basic and most common type of CAPS is CAPS I, for all ages and cities with 15,000 people or more. The other general type of CAPS are CAPS II and CAPS III, aimed at people of all ages and cities with 70,000 people or more and 150,000 people or more, respectively. There are also CAPS' types for specific groups of people. CAPS i are specialized in children and teenagers, while CAPS AD and CAPS AD III are specialized in substance abuse treatment.

The Regulatory Ordinance of 2002 also defined that the federal government should provide financial support for the construction of the centers, and then monthly financial support for their maintenance. For construction, financial support varies from 800,000 to 1,000,000 BRL. For maintenance, monthly support varies from 30,000 to 100,000 BRL. In order to get a CAPS and the financial support, a municipality must send an application to the federal government, which then approves it or not. We had access to the decisions made by the federal government in 2019. Very few proposals were rejected. Among those rejected, the main reason for rejection was the population criterion.

In general, all types of CAPS deliver care following standard procedures. When a patient visits a CAPS for the first time, he/she is interviewed by a professional responsible for giving an initial diagnosis. If it is decided that the patient will be treated in CAPS, a multidisciplinary team – composed mainly of psychiatrists, psychologists, occupational therapists, and social workers – takes care of the case. Then, it develops actions related to the patient's needs, such as consultations with a psychologist, medication use, participation in therapeutic workshops,

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[4]The primary care offered by the public system in Brazil is organized around units called Basic Healthcare Units (or UBS).

clinical exams, and group therapies. Overall, mental health treatment delivered at CAPS has as an explicit goal the social reintegration of individuals into the society and the strengthening of community and family ties.

Following a similar logic, the centers also deliver substance abuse treatment, with Psychosocial Care Centers Alcohol and Drugs (CAPS AD) being designed specifically for such purpose. In particular, they offer individual and group care, as well as home visits and outpatient detoxification. Still, these centers can work in partnership with hospitals, referring more severe cases for inpatient detoxification. The multidisciplinary teams from CAPS adopt several prevention practices aiming to reduce the abuse of substances by its patients. They carry out educational activities to warn about the consequences of alcohol and other drug abuse, offer alternative leisure activities such as physical activities and crafts, and work with the community and the patient's family to reduce risk factors associated with substance abuse.

Finally, there are a few differences between the different CAPS' types regarding infrastructure. CAPS III and CAPS AD III are the only centers that open on weekends and deliver night care; the other centers operate from Monday to Friday in two 4-hour shifts. They are also the only centers with ambulatory beds that can shelter patients needing monitoring.

2.2 Conceptual Background

Since the main component of the psychiatric reform are the CAPS and we exploit their implementation to assess the effects of the reform, it is important to understand conceptually how these centers may affect the outcomes of interest and how we can empirically investigate these channels.

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If the reform is affecting the delivery of mental healthcare in the intended way, we should see an effect of CAPS on mental hospital admissions. This effect may be associated to supply- and demand-driven declines in hospitalizations due to mental illness. Since one of the psychiatric reform's goals is to replace inpatient care, it is possible that the CAPS' establishment in a municipality is followed by the closure of psychiatric beds, which in turn could lead to a reduction in hospitalizations. We can empirically test such a hypothesis. We can also estimate the CAPS' effects on hospitalizations rates due to mental illness and look for heterogeneous effects according to some groups of causes within mental illnesses. As previously mentioned, CAPS also became the first point of entry into publicly funded mental health services after the Psychiatric Reform Law. So, if they have increased access to mental health care, they may also have increased hospital admissions by referring more previously under-served individuals to inpatient care. However, this should happen only for exceptional cases, so we do not expect this to be a major driver behind our results. Several studies suggest that community-based care through outpatient services may substitute hospital admission related to mental illness. In particular, researchers often advocate that community mental health services provide a filter-effect along the pathway to inpatient care (Shaeffer et al., 1978; Wanchek et al., 2011; Madianos and Economou, 1999). Thus, if the CAPS' opening is associated with increased utilization of outpatient mental healthcare, we expect an increase in the number of treatments delivered in the community, reducing demand-driven inpatient care.

All the aforementioned effects constitute the channels through which mental health can be affected, which is the ultimate goal of the reform. We can evaluate this effect on mental health by looking at mortality outcomes. Premature death among individuals with mental disorders can

be related to several chronic conditions such as cardiovascular, respiratory, and infectious diseases, diabetes and hypertension. However, these conditions are not just related to mental illness. Therefore, we evaluate causes of death more directly associated with mental health, all of them recently entitled under the label "deaths of despair" (Case and Deaton, 2015, 2017; Ruhm, 2018). More specifically, we evaluate suicide, overdose, and alcoholic liver disease.

The literature has reported striking associations between mental illness and suicide, as well as high prevalence rates of comorbidity between substance use disorders and other mental and behavioral disorders. To put it in perspective, it has been found that about 90% of suicides are associated with a psychiatric illness (Cavanagh et al., 2003), and that the proportion of schizophrenic individuals with substance abuse disorders can reach 70% (Winklbaur et al., 2006). Following Case and Deaton (2015, 2017) we also consider a broader definition of alcohol-related mortality, by incorporating deaths coded as unspecified sources of chronic liver diseases into the alcoholic liver disease category. In particular, chronic hepatitis and cirrhosis.[5] Finally, we also investigate deaths coded with an underlying primary cause of mental and behavior disorders.

The expected effects of CAPS on mortality rates depends on how centers affected the demand for mental health care and the effectiveness of CAPS' care relative to alternatives to prevent deaths by these causes. The effects are far from obvious. If CAPS increased the demand for mental health care, and these centers are suitable to prevent deaths related to mental illness among individuals that, in the absence of CAPS, would not be demanding mental healthcare, we should expect a decrease in

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[5]As suggested by Ruhm (2019), this definition may be too broad since the added deaths will not necessarily involve alcohol.

mortality rates. If the CAPS' introduction in a municipality causes a shift from inpatient to community-based care, and both types of care are not perfect substitutes, the effects may be ambiguous.

The effects may also depend on the type of mental health services provided at CAPS and the specific cause of death being evaluated. While et al. (2012) and Pirkola et al. (2009) report a positive association between community care and suicide prevention in the presence of well-developed community mental-health services. In particular, the results presented by Pirkola et al. (2009) are driven by the provision of community services available 24 hours a day. In our setting, only CAPS III and CAPS AD III deliver night care and stay open on weekends. These centers are available for only 3 percent of the Brazilian municipalities.[6] Thus, it is possible that the association between community-based care and suicide is not present in our context. Previous research has also shown that service-related risk-factors for suicide include poor continuity of care in the community after hospital admissions, nonadherence to treatment, reduced care in the community, and short length of inpatient care (Bassett and Tsourtos, 1993; Hunt et al., 2009; King et al., 2001). Hence, the CAPS' effects on suicide may be positive or negative depending on the quality of care provided in both mental health centers and hospitals, and which of these types of care are more adequate to prevent deaths caused by suicide.

Besides suicide, the others causes of death we investigate are related to substance abuse. As improved mental health may reduce substance abuse, any CAPS providing mental health treatment has the potential to reduce substance-abuse-related deaths. However, the CAPS Alcohol and Drugs (AD) were created specifically to deliver substance abuse

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[6]Based on the last Brazilian Census (2010), only 187 cities – out of 5570 – had at least 150,000 inhabitants.

treatment. Swensen (2015) shows that increased supply of mental units providing substance abuse treatment reduced drug-related deaths in the U.S. Similarly to our context, the treatment facilities studied by the author deliver mostly outpatient treatment services, but may also refer more severe cases to residential and hospital inpatient settings. Hence, it is possible that similar effects are also present in our context. Yet, one may also consider that the CAPS' effects on substance-abuse-related mortality depend on the incidence of causes CAPS might prevent. Differently from the U.S. context, overdose is an extremely rare event in Brazil. In the period 2002-2016, such cause of death corresponded to only 0.05% of total deaths. The fraction attributed to alcoholic liver disease is 0.83% (1.7% if we consider the broader definition).

Given the depicted pattern, we should expect that the introduction of CAPS AD is more likely to be associated with a decrease in alcohol-related deaths than other drug-related deaths. Indeed, the literature reports that alcoholic cirrhosis deaths can be entirely preventable by treatment for alcohol use disorders (e.g., Rehm et al. (2013)). Still, the development of the disease into more severe stages takes some time. Therefore, we do not expect that CAPS AD would prevent future comorbidities among healthy individuals in the short run. The climbing of liver disease among individuals already compromised by alcohol abuse, however, can be deterred. According to experts, liver cirrhosis has no cure and is associated with high mortality rates. However, a prolonged life expectancy exceptionally requires patients to stop drinking. Any medical and surgical treatments for alcoholic liver disease are limited when drinking continues (Addolorato et al., 2016; Tilg and Day, 2007). Empirical evidence on the topic indicates that abstinence increases the survival rates of patients with alcoholic cirrhosis, even in the short run (Xie et al., 2014). Hence, if treatment delivered at CAPS effectively reduces alcohol

abuse, the centers' adoption may cause a reduction in mortality due to alcoholic liver disease among patients already with some liver comorbidity. Based on reports from professionals working at CAPS, de Souza et al. (2014) reveal that liver cirrhosis's prevalence is high among patients.

Finally, we analyze the CAPS' effects on crime using homicide rates.[7] Theoretically, the effects may again be ambiguous. The psychiatric reform may have increased homicides mechanically by reducing mental hospitalizations as inpatient admittance has an incapacitation effect (Landerso and Fallensen, 2020). Such an impact may be economically significant as there is extensive evidence in the literature that individuals with severe mental illness are at high risk of involvement with violent crimes (Rueve and Welton, 2008). However, we study hospital depopulation parallel to the expansion of community-based mental treatment. The introduction of CAPS may reduce crime if these centers are able to improve the mental health of under-served people to the point of controlling violent behavior. Still, the impacts depend on whether treatment meets the medical needs of crime-prone patients. This goes back to a long-standing debate.

Severe mentally ill persons at risk of becoming criminalized need a safe and secure setting, where staff can monitor and contain aggressive behavior, formulate an appropriate treatment, and monitor psychiatric medications (Lamb, 2015). Hospitals often share this structure. Some specialists advocate that these needs can also be met in community treatment facilities provided there are enough investment (Slate et al., 2013). In particular, Dvoskin and Steadman (1994) highlight that intensive case

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[7]Brazil does not have a reliable and easily accessible crime data. Still, using data compiled by the police in two Brazilian states from 2001 to 2011, Dix-Carneiro et al. (2018) show that homicides recorded by the health system is highly correlated with police-recorded homicides and violent crimes against the person (excluding homicides).

management available 24-hours per day and a comprehensive array of community support services are the keys to reduce the risk of violence by people with serious mental illness in the community. However, Lamb and Bachrach (2001) argue that the inadequate and underfunded community treatment of persons who are the most difficult to treat is a common reality of the deinstitutionalization process in several countries that may have set the stage for criminalization. In Brazil, the vast majority of CAPS does not have the infrastructure to deal with patients in outbreak situations. Thus, the reform may have increased violent crime by shifting away mentally ill individuals from hospital admissions without providing structure for intensive care in the community. Finally, persons with mental disorders may be more vulnerable to violent situations that take place in the community. Therefore, increased risk of crime victimization may also explain a potential association between the mental health reform and homicides (Walsh et al., 2003).

3 Data

We employ administrative data from the Brazilian Ministry of Health. With the support of local and regional public health agencies, the Ministry of Health is responsible for managing different information systems that result in datasets containing records of deaths, hospitalizations, ambulatory procedures, and health facilities. These data are described in more detail next. We merge information across datasets using identifiers for municipalities, which constitute our unit of analysis. Municipalities are the smallest administrative units in the Brazilian political system and are the geographical level in which the policy takes place. Since some cities were created during the period, we aggregate them into minimum

comparable areas.[8] For ease of exposition, we will hereinafter refer to minimum comparable areas as municipalities.

Through the Information Access Law, the Ministry of Health also provided us with data on the implementation of each CAPS. These data cover the period between 2002 and 2019 and contain the date of opening and the type of every CAPS active as of June 2019 created after the CAPS law was sanctioned in 2001. A few CAPS created before this period were accredited to 2002. So, we were unable to distinguish municipalities that adopted a CAPS in 2002 from those that previously adopted. Hence, we only exploit variation from 2003 onwards. Appendix Figure A.1 depicts the number of municipalities adopting a mental health center by CAPS' types over time, starting in 2003. The vast majority of municipalities with a community mental health center implemented a CAPS I (80%). Additionally, most of the cities adopted only one center during this period (see Appendix Figure A.2).

The Hospital Information System of the Unified Health System (SIH) provides information about hospital admissions using beds of the public health care sector. The data provide information on admissions by municipality of residence of the patient by cause, coded using the ICD-10. The whole dataset covers the period between 1995 and 2019. Also from the Ministry of Health, the Mortality Information System (SIM) provides data on deaths in the country from 1996 to 2017, including causes coded using the ICD-10. We rely on the ICD classification to identify causes of death and hospitalization related to mental illnesses and group them. Table A2 summarizes the relationship between groups and ICD-10 codes.

The Ministry of Health provides detailed data on all private and public health facilities in Brazil through the National Registry of Health Es-

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[8]To do so, we rely on data provided by the Institute of Applied Economic Research (IPEA).

tablishments (CNES). This dataset includes information about health professionals linked to some healthcare facility, including practice and levels of specialization. For this study, we select, for each municipality, the number of different mental health providers that usually constitute community mental health teams: psychiatrists, psychologists, occupational therapists, and social workers. These represent, on average, 87% of all the professionals working at the psychosocial care centers. These data also provide information regarding the number of hospital beds in each municipality. We select those that, according to the registries, are specifically used for psychiatric patients.

We use the National System of Information on Ambulatory Care (SIA) to investigate the CAPS' effects on outpatient mental health care. Ambulatory visits may take place in any health facility that provides primary health services. For the period 1994-2019, SIA provides administrative information on all ambulatory visits funded by SUS in which medical care is provided on an outpatient basis. Severe compatibility issues limit the use of this dataset. Microdata is at the procedure level, and many procedure codes change over time. There is no direct way to make codes compatible. Hence, with few exceptions, we avoid evaluating specific ambulatory procedures. From 2008 onward, we are able to identify the type of health professional that provided the outpatient care. We then select the overall number of ambulatory services made by each of the mental health providers we are evaluating (psychiatrists, psychologists, occupational therapists, and social workers) to analyze the supply of outpatient health care. To assess indicators of compliance with the policy, we also select "psycoshocial care procedures", which are available since 2002. Those include a roll of outpatient services (medical consultations, psychotherapy, group therapy, etc.), specifically defined to be performed at CAPS. SIA also contains information on "outpatient

pharmaceutical assistance", in which drugs are dispensed for patients to use at home. We select the number of antipsychotic drugs dispensed in each municipality.

We also use additional data on municipality characteristics to control for differential trends in important determinants of mental health in our estimates of the CAPS' effects on the outcomes of interest. The Brazilian Statistical Office (IBGE) provides estimates of population for each municipality by year, and GDP for each municipality from 2002 to 2016. From the Ministry of Social Development (MDS/SAGI), we collect data on *Bolsa Família* Program (PBF) spending for each municipality.[9] Finally, we obtained data from the Brazilian Ministry of Health on the age and gender composition of the municipalities' population.

We complement our dataset with crime data for the state of São Paulo provided by the state's Public Security Secretariat and accessed through the *Sou da Paz Analisa* platform, developed by the Sou da Paz Institute.[10] We use data on robberies, thefts, attempted murders, and drug-related crimes (drug possession and drug trafficking) for each municipality of the state of São Paulo from 2002 to 2016.

Our main sample consists of balanced yearly data for 5,180 municipalities and covers the interval between 2002 and 2016. Table A1 provides summary statistics.

4 Study Design and Estimation Strategy

We exploit the sequential process of implementation of CAPS starting after 2002 and adopt a difference-in-differences (DID) strategy to ana-

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[9]PBF is the main conditional cash transfer policy in Brazil.

[10]Sou da Paz Institute is an NGO that has been acting for 20 years on public security in Brazil, producing studies on the theme and engaging the population on related issues.

lyze the effects of this intervention on public mental health and mortality by assaults. In such a setting, researchers often employ two-way fixed effects regression models. There are two commonly adopted specifications. In one of them, a single treatment dummy is added to the regression. This approach has been shown to be invalid if treatment effects are heterogeneous over time or across cohorts. In particular, the linear regression coefficient may be negative even if the treatment effect is positive (Goodman-Bacon, 2018). The other widely used specification results from adding lags and leads of treatment to the regression. However, estimates from these models may not be causally interpretable (Abraham and Sun, 2018). In this paper, we follow De Chaisemartin and d'Haultfoeuille (2020) and estimate well-defined and relevant causal parameters, robust even if treatment effects are heterogeneous across groups or over time.[11]

We start defining our causal estimands of interest. Let D_{mt} denotes our treatment dummy. For our main empirical strategy, it indicates whether a municipality m gained a CAPS (of any type) for the first time in year t. We are interested in the average treatment effects across the municipalities that sequentially implemented a mental health center after 2002. That is, (m, t) cells such that $D_{mt-1} = 0$ and $D_{mt} = 1$ for any pair of consecutive time periods $t - 1$ and t. Let $\mathcal{S}$ denotes the set of switching cells and $N_{\mathcal{S}}$ its cardinality.[12] One of our primary causal estimands is

$$\beta_{\mathcal{S}} := \frac{1}{N_{\mathcal{S}}} \sum_{(m,t) \in \mathcal{S}} Y_{mt}(1) - Y_{mt}(0), \tag{1}$$

where $(Y_{mt}(0), Y_{mt}(1))$ are the potential outcomes without and with treat-

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[11]In such a staggered design, the estimators we use are very similar to those proposed by Abraham and Sun (2018) and Callaway and Sant'Anna (2019) (for this particular case, in a specification without covariates).

[12]In particular, $\mathcal{S} := \{(m, t) \in \{1, \ldots, M\} \times \{1, \ldots, T\} : t > 1, D_{mt-1} = 0, D_{mt} = 1\}$, where M is the size of our population and T denotes the last year of our panel.

ment of municipality m at period t. $\beta_{\mathcal{S}}$ is the average treatment effect across all groups of switchers, at the time when a groups starts receiving the treatment. We are also interested in dynamic treatment effects. These parameters can be defined similarly to (1), by evaluating $Y_{mt}(1) - Y_{mt}(0)$ one time period or more after t across the treated (m, t) cells.[13] The CAPS' implementation process across the municipalities has been taking place slowly and steadily over the years. So, we may not be able to identify longer-run effects due to compositional changes arising from the fact that late switchers will have a lot of missing post-CAPS years. For example, if municipalities selection timing is based on expected future gains, the dynamic effects for early-treated cities may not be representative for those who received a CAPS later and have missing post-CAPS data. In our primary analysis, we will look up to five post-intervention effects. About 65 per cent of our treated units had a CAPS in operation for at least 5 years. We also consider an estimand that restrict the dynamic effects only for cities that have at least five periods of post-CAPS observations.[14]

Under a parallel trends assumption, the outcome evolution among the non-switchers can be used as the counterfactual evolution of the switchers, and a DID estimator that compares the outcome of both groups before and after the intervention can estimate average treatment effects among the switchers. We now present such an estimator. For any $t > 1$, let $\mathcal{S}_t$ be the set of municipalities that became treated at period t. Define $\mathcal{C}_t$ as the set of control municipalities at period $t - 1$ that did not gain a CAPS at period t. Let $N_{\mathcal{S}_t}$ and $N_{\mathcal{C}_t}$ be the number of municipalities in

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[13]We shall also impose additional restrictions on $\mathcal{S}$. For example, $t < T$ for the treatment effects one year after CAPS' implementation.

[14]In this case, since the composition of municipalities is the same across all event times, longer-run dynamic effects cannot be biased due to compositional changes. However, the loss of groups used to compute the dynamic effects can lead to less informative inference. See Callaway and Sant'Anna (2019) for an interesting discussion on compositional changes and dynamic effects.

each set. We first define the DID estimator for the coohort of municipalities that implemented a CAPS at period t:

$$DID(t) := \frac{1}{N_{\mathcal{S}_t}} \sum_{m \in \mathcal{S}_t} (Y_{mt} - Y_{mt-1}) - \frac{1}{N_{\mathcal{C}_t}} \sum_{m \in \mathcal{C}_t} (Y_{mt} - Y_{mt-1}). \quad (2)$$

$DID(t)$ compares the evolution of the mean outcome between $t-1$ and t in two sets of groups: the municipalities that gained a CAPS at the period t ($\mathcal{S}_t$), and those remaining untreated ($\mathcal{C}_t$). Under the assumption that the mean outcome of municipalities in $\mathcal{S}_t$ and $\mathcal{C}_t$ would envolve in parallel in the absence of CAPS' implementation, $DID(t)$ estimates the average treatment effect for the switchers of period t, at the period they became treated. We can then define our estimator for $\beta_{\mathcal{S}}$, which is a weighted average of the $DID(t)$ estimators:

$$DID_M := \sum_{t=2}^{T} \frac{N_{\mathcal{S}_t}}{N_{\mathcal{S}}} DID(t). \quad (3)$$

De Chaisemartin and d'Haultfoeuille (2020) show that under a parallel trends assumption, DID_M is an unbiased estimator for the average treatment effect among switchers, at the time period when they switch. We also use estimators for the dynamic treatment effects, which can be defined in a similar way, by using long-differences $Y_{mt+k} - Y_{mt-1}$, for $k > 0$, instead of first-differences, provided that there are stable control municipalities in the post-CAPS periods.[15] Regarding inference, we compute standard errors using a municipality-level clustered bootstrap.

Our research design uses groups whose treatment is stable to infer the trends that would have affected switchers if they had not implemented a CAPS. This design would not be valid only if, indepen-

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[15]It must exist a non-empty subset $C_{t+k} \subset C_t$ of not-yet treated municipalities at period $t+k$. This is always satisfied in our context as there is a group of never-treated cities.

dent of CAPS' implementation, there were differential trends in time-varying determinants of outcomes across switchers and municipalities whose treatment is stable. To deal to some degree with those potential issues, our main specification includes state-specific non-parametric trends. These may be particularly relevant in the Brazilian context as various public policies – such as those related to education and public security – are at least partly determined at the state level. We then test the sensitivity of our results to the inclusion of controls for differential trends in the changes of some health determinants. More specifically, we control for local economic condition measured by GDP per capita, and the age-by-gender composition of the municipality population (the share of inhabitants within each 9-year-by-gender bracket, from 10-19 up to 79 years). We also consider more flexible trends according to per capita spending with *Bolsa Família* program, as this policy started expanding across the Brazillian municipalities in the beginning of our sample. Reassuringly, point estimates are stable to different specifications, suggesting that our results are unlikely to be driven by differential trends across switchers and non-switchers. Next, we present more formal analysis that support our design validity.

One way to assess the plausibility of our identification assumption is to follow Galiani et al. (2005) and Rocha and Soares (2010) and estimate a hazard model of the probability of a municipality receiving a CAPS. We perform this estimation by modifying the data, so each municipality leaves the sample after receiving a CAPS. Then, we estimate a logit model controlling for a flexible polynomial of time, where the dependent variable is a dummy indicating that a municipality received a CAPS and the independent variables are socioeconomic variables. More specifically, we estimate three models considering the first, second, and third lags of the changes in our variables of interest, as well as these vari-

ables at the baseline year. We additionally selected some socioeconomic variables from the 2000 Census to use as controls.[16]

Our goal is to evaluate whether municipalities actually applied and received a CAPS after being subject to an economic or mental health shock, which could violate our identification assumption. Results are reported in Table A3 as marginal effects calculated on averages of the independent variables. Overall, we find that some baseline characteristics are correlated with the probability of receiving a CAPS. Municipalities with greater homicide rates at the baseline, with more inequality (based on the Theil index), and more urban had a greater probability of receiving a CAPS. However, the effects are quantitatively small – the effects of one standard deviation are all smaller than two percentage points. Furthermore, and fundamental for our identification assumption, we don't see any correlation between receiving a CAPS and past shocks on mental health indicators, income, and homicides rate. This provides evidence of the validity of our empirical strategy.

More generally, we can estimate treatment effects for the treated (m, t) cells using pre-CAPS periods $t' < t$, to judge directly the plausibility of the underlying parallel-trends assumption defining our DID design. De Chaisemartin and d'Haultfoeuille (2020) propose a placebo estimator, DID_M^{pl}, that compares switchers and non-switchers before the switchers switch treatment. The placebo estimator for the year before the CAPS' introduction, for example, compares the outcome's evolution from $t - 2$ to $t - 1$, in municipalities that switch and do not switch treatment between $t - 1$ and t. $\mathrm{E}[DID_M^{pl}] = 0$ under basically the same assumptions

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[16]We consider lagged changes in rates (per 10,000 people) of: hospitalizations related to mental & behavioral disorders; deaths related to mental & behavioral disorders; deaths related to self-inflicted injuries; deaths of despair; homicides; and $sinh^{-1}$(GDP per capita). For the independent variables at the baseline, we consider the values of the same variables in 2003 as well as some variables we get from the 2000 Census: the Theil index, the shares of illiterate people, poor people, and people living in rural areas in the municipality.

that guarantee that $E[DID_M] = \beta_\mathcal{S}$.[17] Following the same logic of the dynamic estimators, we can also estimate more distant placebo effects, provided that there are stable municipalities. In our baseline results, we estimate five placebo effects. Nearly all outcomes we evaluate display no pre-trends. Finally, in Section 7, we show that the CAPS' establishment is not correlated with placebo outcomes that could reflect unobservable policies or trends.

5 Main Results

We present our main results in graphical form, plotting together in the same figure the estimated dynamic treatment effects using the DID_M estimator, the estimated placebo treatment effects using the DID_M^{pl} estimator, and respective 95% confidence intervals computed with a municipality-level clustered bootstrap. We also present in the same figure, two alternative specifications. First, we include non-parametric state-specific trends. Further, we adjust for GDP *per capita*, PBF spending, and the age-by-gender composition of the municipality population.

The different sets of results are presented in four subsections. In the first, we present the relation between CAPS' implementation and indicators of access and utilization of outpatient mental health care. In the second, we present the CAPS' effects on mental health measured by hospitalization and mortality caused my mental illness and behavior disorders, suicide, and substance abuse. In the third subsection, we discuss the effects of centers delivering substance abuse treatment. In the fourth and final subsection, we present the relation between CAPS' opening and homicide rates.

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[17]We also need the existence of stable groups to estimate the placebo effects.

5.1 Access and Utilization of Mental Health Care

5.1.1 Psychosocial Care Procedures

Before proceeding to our main results, we first use the proposed estimation strategy to present the relation between the CAPS' introduction and psychosocial care procedures, which include a roll of outpatient services delivered at these centers. Figure 2 plots the event-study results for this relation. Although such effects should be mechanical, they provide evidence of timing and compliance with the policy. Point estimates indicate that psychosocial care procedures jump right after the introduction of CAPS in a municipality and then rise steadily. This evidence suggests a wide use of these centers by the local population as soon as they are implemented. A summary parameter defined by the average of the event-specific estimates indicates that CAPS delivered yearly 461 (s.e. 13) procedures by 10,000 people.

We can also characterize the type of care provided at CAPS, using a restricted sample. Until 2012, most of the provided care were labeled as non-intensive – for patients needing monthly assistance, semi-intensive – for weekly visits, and intensive – for patients with almost daily care. Appendix Figure A.3 shows that during the period 2002-2012, most visits took place on a monthly basis (an average of 234, s.e. 8, procedures by 10,000 people), followed by weekly care (153, s.e. 6), and then daily care (84, s.e. 3). Until 2012, psychosocial care procedures were also registered alongside with an ICD-10 (Chapter V). Appendix Figure A.4 shows that most CAPS' patients had schizophrenia and mood disorders, which consists basically of bipolarity and severe depression.

5.1.2 Mental Health Practitioners

We start by showing the policy effects on the supply of mental health practitioners. Figure 3 plots such results. Estimates presented in panel (a) indicate a remarkable increase in the supply of psychiatrists that precedes the CAPS' introduction and reaches its peak one year after the policy's beginning, declining slowly after that. The treatment effects estimate for the year before the policy implementation indicates a statically significant increase of 0.07 psychiatrists per 10,000 people, or a 25 percent increase compared to the average in period -5 for the treated. One year after the CAPS' introduction, treatment effects are almost three times higher: 0.19 points (70 per cent). Treatment effects decay monotonically after that, reaching 0.11 points by year-5.

We also estimate the relation between CAPS and other mental health providers that usually constitute community mental health teams: psychologists (panel (b)), occupational therapists (panel (c)), and social workers (panel (d)). Overall, the pattern is similar to what we have found for psychiatrists. CAPS' effects on the supply of these professionals are significant and high in magnitude. As before, there are anticipation effects, most marked at the year before the establishment of CAPS. Treatment effects then rise until one year after the beginning of the intervention. The number of psychologists per 10,000 inhabitants increased by 0.26 (35 per cent) in the first year after CAPS' adoption. Point estimates decline until the fifth year, reaching treatment effects of 0.11–0.22 (15–30 percent), depending upon the specification. One year after the program, CAPS' effects on the rates of occupational therapists and social workers are 0.09 (60 per cent) and 0.27 (61 per cent), respectively. They remained constant in subsequent years.

Overall, our results indicate that the CAPS' implementation in a mu-

nicipality represents a large increase in the local supply of mental health providers. This may be particularly important for small municipalities, which lack an appropriate supply of such professionals. Moreover, the results are in line with the best practices recommended by researchers regarding the supply of community-based mental health care. Studies argue that this type of care should rely heavily on human resources, and should be based on a multidisciplinary team (e.g., Thornicroft and Tansella (2004)).

The psychosocial care centers take some time to be built, and local governments are expected to hire new professionals in advance to work in the centers when they start operating. We have some anecdotal evidence from private conversations with municipality health officials that this indeed frequently happens. This practice is probably the reason behind the anticipation effects we have found. In line with this channel, we show next that overall outpatient procedures made by mental health providers increased only after the CAPS' introduction. This is also indicative that the practice of hiring professionals in advance shall not cause differential pre-trends in our primary mental health outcomes.

5.1.3 Outpatient Care

After confirming that CAPS led to a substantial increase in the supply of mental health practitioners, we turn to the analysis of outpatient care made by these professionals, which constitute our main indicator of the CAPS' effects on the usage of community-based mental health care. These results are shown in Figure 4. In the pre-CAPS period, estimated treatment effects provide no evidence of differential trends across treated and untreated areas. One year after the CAPS' introduction, the number of outpatient procedures made by mental health providers increased remarkably, attaining treatment effects of 132 (197 per cent) for psychia-

trists, 75 (66 per cent) for psychologists, 18 (78 per cent) for occupational therapists, and 34 (94 per cent) for social workers.[18] The gap in the number of ambulatory procedures made by psychiatrists decreased in the subsequent years. Contrary, the gap increased for the procedures made by psychologists, occupational therapists, and social workers. Overall, our results indicate that number of ambulatory procedures specific to mental health increased remarkably after the CAPS' introduction in a municipality.

As most of the ambulatory procedure codes change over time, we avoid evaluating specific procedures related to mental health. There is one exception: therapeutic workshops, whose primary goal is to reinsert patients with mental and behavior disorders into social life. The workshops are taught by professionals with complete college and involve activities like craft, music, dance, among others. This kind of procedure can be delivered at any primary-care health facility. Figure Appendix Figure A.5 presents the relation between CAPS' opening and therapeutic workshops. In the subsequent years after the CAPS' introduction, therapeutic workshops increased by approximately 0.7 per 10,000 inhabitants, which is equivalent to an 60 percent increase compared to the average in the pre-CAPS period. This result is consistent with one of the CAPS' goals, which is to provide more humane mental health treatment.

Finally, we analyze the relation between CAPS' introduction and the dispense of antipsychotic drugs. These medications are mostly used to treat schizophrenia, but they may also be suited for other diseases that cause psychotic episodes. Figure 5 presents our event-study plots. The number of dispensed antipsychotic medications (per 10,000 people) increased steadily in treated areas one year after the CAPS' introduction

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[18]In parenthesis, we present the effects relative to the average within the treated in the pre-CAPS period.

compared to control municipalities. Estimates are less precisely estimated for the last years. But, even if we consider the lower bound of the 95%-confidence-interval, results indicate that by year-5, CAPS increased the rate of dispensed antipsychotic drugs by at least 7 points, or 175 per cent compared to a pre-CAPS mean of 4 drugs per 10,000 people. As medical therapy is one of the most common treatments within mental health ambulatory care, this is another evidence consistent with CAPS increasing utilization of outpatient mental health care.

5.2   Hospital Admissions and Mortality

Consistent with a new emphasis on community-based services to provide mental health care after the psychiatric reform, municipalities constructing a CAPS may have closed psychiatric beds. Such a reaction could be behind any potential effects of the policy on hospitalization outcomes. Figure 6 presents the relation between CAPS' opening and psychiatric beds. There is no evidence of differential trends in the number of psychiatric beds neither before nor after the CAPS' introduction.

We then turn the analysis to the CAPS' effects on hospital admissions due to mental and behavioral disorders. In Figure 7, we do observe a clear tendency for sharp reductions in mental hospitalization rate upon the arrival of CAPS. In the first year after the CAPS' establishment, the admissions rate decreased by 0.9 points in treated areas compared to control municipalities, or by 7.2 percent from the pre-CAPS mean. In the subsequent years, the point estimates are marginally lower. Still, the average effect over the post-CAPS period points to a yearly reduction of 0.64 (s.e. 0.29) – 0.8 (s.e. 0.27) hospitalizations by 10,000 people, depending upon the specification. Figure 8 indicates that the CAPS' introduction is mostly associated with reductions in long-stay hospitalizations

($>$ 30 days). Differently from overall hospitalizations, the reduction of long-stay admissions is less pronounced in the short run, but the treatment effects are monotonically increasing over time. Our evidence indicates that community-based services introduced by the centers may have shifted patients away from hospitals, especially those who, otherwise, would be hospitalized for an extended period.

Figure 9 examines hospitalization results by different groups of causes. Panel (a) suggests that reductions in hospital admissions due to schizophrenia primarily drive the CAPS' effect on hospitalization rates. These rates decreased by 0.6 points (11 per cent) in the first year, and remained nearly constant after that. For the other groups of causes, there are very few statistically significant and negative effects. After CAPS' introduction, there seems to be a tendency for hospitalizations due to mood disorders (panel (b)) to decline in treated areas. However, treatment effects are less precisely estimated depending upon the specification.

Figure 10 presents the CAPS' effect on mental health measured by deaths caused by suicide (panel a), alcoholic liver disease (panel b), overdose (panel c), and mental and behavioral disorders (d). The estimates, in general, indicate no effect. Breaking down suicides and mental disorders by groups of cause and using a broader definition of alcohol-related mortality do not reveal any new evidence. One may consider that mortality is an extreme outcome in our setting. So, given the variability of the measures, it can be that the effects exist, but are too small to be detected. In the next subsection, we will show that the centers specifically designed to deliver substance abuse treatment (CAPS AD) reduced mortality by alcoholic liver diseases.

Our results indicate that public policies aimed at providing community mental health care can be effective at reducing hospital admissions due to mental illness without increasing mortality outcomes. In

our context, the reduction in hospitalizations was driven by individuals with schizophrenia and related disorders, who are usually high users of inpatient services (Madianos and Economou, 1999). This is consistent with our previous results, which indicated a frequent usage of Psychosocial care services among schizophrenic individuals and pointed to an increase in the drugs dispensed to treat such disorder. Additionally, our results were driven by the reduction of long-stay hospitalizations, rather then sporadic inpatient admittance. Therefore, it seems that CAPS shifted health care for severe mental disorders from the inpatient level to the community. This can be seen as a positive result of the policy since researchers indicate that community mental health care provides more humane treatment for patients. Moreover, this kind of treatment is usually cheaper. However, a recurrent concern is that the increased presence in the community of severe mentally ill persons that, otherwise, would be hospitalized may positively affect local criminality. We investigate this later.

5.3   Substance Abuse Treatment

Now, we discuss a major difference between the different types of CAPS, related to the treatment of alcohol and drug abuse. The Psychosocial Care Centers Alcohol and Drugs (CAPS AD) are specific for such purpose. We showed in Figure A.4 that, overall, very few procedures made in CAPS are related to psychoactive substance abuse, in comparison to other mental disorders. However, when one looks specifically to CAPS AD, the pattern is totally different. On average, 133 outpatient services (per 10,000 inhabitants) related to substance abuse are delivered in these centers by year (see Figure A.6). Therefore, one may expect different results for this type of CAPS on substance-abuse-related outcomes. To

capture variation coming only from the implementation of CAPS AD we control for the adoption of other centers.

To analyze whether, concerning substance abuse treatment, the implementation of CAPS AD caused a shift from hospital care to community-based care, Figure A.7 examines the effects of CAPS AD on hospital admissions. All point-estimates are negative, but imprecisely estimated. For some event times the dynamic effect may be as high as 0.8 (10 percent compared to the pre-CAPS mean 7.4 hospital admissions), the average effect over the event-times is low: -0.39 (s.e. 0.36). Therefore, CAPS AD may have reduced inpatient care, but the effects are not substantial.

Figure 11 presents our main results: the effects of CAPS AD on substance-abuse-related deaths. Panels (a) and (b) presents variables that constitute deaths of despair: intoxication of alcohol and drugs (intentional – suicide, or not – overdose), and alcoholic liver disease. In panel (c), we present the effects on deaths coded with an underlying primary cause of psychoactive substance abuse disorders. We found significant results for alcoholic liver disease. Estimates indicate that before the establishment of CAPS AD, treated and control municipalities had very similar trends in the rates of deaths caused by alcoholic liver disease. Then, the creation of CAPS AD is associated with a decrease on deaths caused by this condition. Treatment effects are monotonically increasing over time, becoming statistically different from zero from year-2: -0.06 deaths by 10,000 people, or 12 per cent compared to the average in the pre-CAPS period (main specification). By year-5 treatment effects rise to 0.09 points (18 per cent). Appendix Figure A.8 presents the results when we consider the more broad definition of alcohol-related mortality. In this case, the point-estimates are higher in magnitude, but treatment effects are the same in relative terms. Therefore, community-based treatment for substance abuse disorders, as measured by the creation of CAPS AD, does

reduce deaths by alcoholic liver disease. This is particularly important for contexts like ours where, differently from the U.S., deaths by alcoholic liver disease are much more prevalent than other drug-induced deaths.

Independent of the disease stage, abstinence from alcohol is the cornerstone of care management among individuals with alcohol-related liver disease. For end-stage liver disease, liver transplantation is one of the only treatments available. If, somehow, liver transplantation became more accessible in the Brazilian public health system parallel the opening of the CAPS AD, this could be behind our results. However, we show in Appendix Figure A.9 that the rates of liver transplants did not change following implementation of CAPS AD (panel a), neither when we analyze transplants performed only in persons with alcoholic liver disease (panel b). It is unlikely that this is a relevant channel in our context.

Finally, we re-estimate the results on deaths by alcoholic liver disease using restricted samples. As CAPS AD are target only to larger cities, it may not be appropriate to use the whole pool of control units, which is mostly composed of smaller cities. Figure A.10 presents the average effects over the non-negative event-times when we restrict the sample to municipalities above the 10th, 25th, 50th, and 90th percentile of the population distribution. For municipalities in the last decile of the distribution, for example, we are left with 279 never-treated municipalities (out of 5,161) and 270 treated cities (out of 315). Overall, the results remain remarkably stable across the different samples, both when analyze only deaths coded as alcoholic liver disease (panel a) or consider the more broader definition for alcohol-related mortality (panel b).

5.4 Homicides

We now access whether CAPS affected homicide rates. Figure 12 presents the results on mortality by assault. Estimates indicate that before CAPS' introduction, treated and control municipalities had very similar trends in homicide rates. Then, the creation of CAPS is associated with an increase in homicides. Considering the specification without controls, we find that one year after the CAPS' establishment, homicide rate increased by 0.16 points in treated areas compared to control municipalities, or by 8 percent compared to a pre-CAPS mean within the treated of 1.9 deaths per 10,000 people. Treatment effects rise to 0.36 (18 percent) by the fifth year. Estimated effects are marginally smaller when we control for state-specific trends (0.23, or 12 per cent, by year-5). Further including controls does not change much our results.[19]

To discuss the magnitude of our results and propose mechanisms, we propose the following quantitative exercise. Under the assumption that the only channel by which CAPS affect mortality by assault is through de-hospitalization, the ratio between the CAPS' effects on homicides and the CAPS' effects on hospital admissions due to mental illness estimates the impacts of de-hospitalization on homicides induced by CAPS. Considering the specification with controls and state-specific trends, the average effects of CAPS on mental health hospitalizations is -0.72 (s.e. 0.24), while the effects on homicides is 0.12 (s.e. 0.04). Therefore, this quantitative exercise predicts that approximately 16% of the des-institutionalized patients got involved in a violent death. Such a ratio remains nearly the same if we focus exclusively on admissions due to schizophrenia or long-stay admissions.

We then try to compare our reduced-form estimate with the results

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[19]Dynamic effects remain remarkably stable if we further control for municipality and pre-determined covariates linear trends.

found by the literature. Using U.S. data and following mental patients during their first year after discharge from the hospital, Steadman et al. (1998) found that the 1-year aggregate prevalence of violence among them varied between 20 and 40 percent, depending upon on the diagnoses.[20] Similarly, Belfrage (1998) found a rate of 40% criminality among individuals with schizophrenia, affective psychosis or paranoia, in a ten-year follow-up of patients who were discharged from mental hospitals in Sweden. More consistent with our results, some papers focus exclusively on violent crimes. Using Israeli data, Fleischman et al. (2014) found that among 3,187 discharged schizophrenic patients, 656 (20%) were later convicted by at least one crime, with 73% of them (480) being involved in a violent crime. Based on a Swedish sample, Fazel et al. (2009) show that the proportion of individuals with schizophrenia committing violent crimes (in a post diagnosis period) is 13.2%. Similarly, Link et al. (1992) report that among former and new hospital mental health patients in the U.S., the proportion of individuals hurting someone badly is 17 and 19 percent, respectively.[21] Finally, there are papers reporting an elevated rate of victimization experienced by persons with severe mental illness (Walsh et al., 2003; Silver et al., 2005; Hodgins et al., 2007; Teplin et al., 2005). Using U.K. data, Walsh et al. (2003) show that the prevalence of violent victimization among schizophrenic patients is 17 percent.

Given the evidence from follow-ups of discharged individuals from mental hospitalizations, discussed above, it is reasonable to assume that at least 40% of the dis-institutionalized mentally ill eventually get in-

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[20]They also show that over the course of the year violence decreased for some individuals, but not for those with a diagnosis of major mental disorder (schizophrenia and other psychoses), who did not also have a diagnosis of substance abuse.

[21]Using data from the Australia, Sweden, U.K., and U.S., studies report similar rates, in the $20 - 40$ percent range (Swanson et al., 2006, 2004; Wallace et al., 2004; Belfrage, 1994; Hodgins et al., 2007; Brekke et al., 2001; Monahan et al., 2001; Hodgins et al., 2007).

volved in a violent situation, either as victims or perpetrators. Our reduced-form prediction (16%) would thus be within this range. However, one has to consider that violent crime is a broader category, and homicides represent just a small fraction of all violent crimes. In particular, using Brazilian data Murray et al. (2013) estimate that homicides appear to be an order of magnitude less common than other violent crimes such as assault. Even so, a few papers report that mental illness is most closely associated with homicides than other violent crimes. Indeed, Fazel and Grann (2006) compute that the population-attributable risk of patients with severe mental illness in relation to homicides is 18%, the highest among all types of violent crime (3% for common assault). Therefore, even if our prediction on the proportion of dis-institutionalized patients getting involved with homicides is relatively high, it may be reasonable given the discussion above. Finally, we also make clear that this quantitative exercise is just exploratory. Depending on whether one increases and/or decreases the CAPS' effects on homicides and hospitalization rates by one standard error, the reduced-form estimate varies from 8% to 35%, making the channel we propose more or less likely.

In order to further assess the link between CAPS and violent crime, we focus on the state of São Paulo, the only state for which crime data is available for a reasonable time frame, allowing us to conduct the same event-study analysis. Since we focus on one state only, the estimates tend to be significantly noisier. However, it is still possible to conduct a qualitative assessment to investigate whether the patterns in the crime data support the results above on violent crime.

The first step is to assess whether we can expect the same mechanisms to be at play in the state of São Paulo. Although it is reasonable to have slightly different results since there can be heterogeneity in the effects of CAPS, we expect the results to be generally in line with what

we found for the full sample. Figure 13 shows the estimates for São Paulo of the effects of CAPS on hospitalization rates related to mental and behavioral disorders, schizophrenia, psychoactive substance abuse disorders (alcohol- and drug-related), and long-stay admissions. Besides the expected noise, it is possible to see that, different from the results for the full sample, the hospitalization rates related to mental and behavioral disorders seem to increase with time after the introduction of a CAPS. This is driven primarily by admissions related to drug and alcohol, which exhibit a similar pattern to the results for the full sample, but stronger. Figure A.11 shows that this effect is driven by centers not delivering substance abuse treatment, while for CAPS AD there is a slight decrease in hospitalization rates, in line with the results for the full sample. This last result is, of course, very noisy, given the reduced number of CAPS AD introduced in this restricted sample and which might also help to explain the positive estimate for the last period.

When we look at hospitalizations related to schizophrenia and long-stay admissions, we see the same pattern we saw for the full sample (but much noisier). Although we do not want to stress the magnitude of the results due to the lack of precision within this sample, it is worth noting that while the point estimates for São Paulo are larger in magnitude than that of the full sample, the baseline rates are also higher. Hence, for both outcomes, the magnitude of the average effect relative to the baseline rate (10.4% and 14.6% for schizophrenia and long-stay hospitalization, respectively) lies within the 95% confidence interval of the magnitude of the full sample estimate.

Next, in Figure 14, panel a, we estimate for São Paulo the results on homicides and, as in the full sample, we see an increase in homicide rates. It is interesting to notice that the average effect is larger than that of the full sample, in line with the increased reduction we see in admis-

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sion rates (in magnitude), which would be consistent with the channel of increased violence due to de-hospitalization.

We then leverage the crime data for the state to see if it is consistent with the mechanisms we proposed for the effect of CAPS on homicide rates. Figure 14 shows in panels b, c, and d the effects of CAPS on robberies, car thefts, and other thefts (i.e., other than car thefts). For robberies, even abstracting from the lack of precision, most estimates are close to zero and the two higher estimates seem to be due to noise rather than evidence of an effect. Hence, we interpret these results as no evidence of an effect of CAPS on robberies. There is also no evidence of any effect of CAPS on car thefts. As for other thefts, given that all estimates but one after the introduction of a CAPS are at the same level as the estimates prior to the introduction, we also interpret this as no evidence of effect of CAPS on thefts.

Finally, we look at drug-related crimes, namely drug possession and drug trafficking, in Figure 14, panels e and f. In the case of drug possession, we see a decline that does not seem to be an effect of CAPS and, indeed, is taken care of when we include our controls. In the case of drug trafficking, we see a very noisy negative effect that might be the result of trends that are not taken care of by our municipality-specific linear trends, or the increase in hospitalization rates due to substance abuse. In any case, the potential effect is not positive, also providing another evidence that only crimes that can be related to serious mental illnesses increase after the introduction of CAPS.

Overall, we find a steady and robust increase in homicide rate after the roll-out of CAPS across the Brazilian municipalities. As previously discussed, our results may indicate that a significant share of mentally ill individuals not institutionalized end up getting involved in homicides. This is consistent with the pattern of our results on hospital admissions.

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First, the results were driven by long-stay hospitalizations, which may have an incapacitation effect. Second, the results were more pronounced among patients with a severe mental disorder, schizophrenia, usually associated with violent behavior. Still, the average effect of CAPS on homicides is just modest: -0.12 deaths by 10,000 people, or 7 percent relative to the pre-CAPS mean.[22] This is also consistent with studies from the literature, which highlight that although persons with mental disorders are at increased risk of committing violent crime, the proportion of total violence attributed to this group is quite small (e.g., Walsh et al. (2002)). Finally, we also show, using data available for the state of São Paulo, that CAPS seem to have an effect only on crimes that can be related to persons with mental disorders (and in particular schizophrenia), while there does not seem to be a relationship between the introduction of CAPS and crimes in general.

6 Robustness Checks

6.1 Alternative Specifications

Since homicides are relatively rare events, data may be very noisy in smaller cities, and results may be affected by possibly spurious outliers. To check whether this seems to be a concern, we adopt a few alternative specifications. Appendix Figure A.12 present such results. In one of the specifications, we place more weight into municipalities with a larger population to check whether there are relevant heterogeneous effects by population size (panel (a)). In panel (b) we discard municipalities bellow the 10th percentile of the population size distribution. In another specifi-

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[22]When put in perspective to externalities from other Brazilian policies on homicides – such as the trade liberalization (Dix-Carneiro et al., 2018) and the transition of a market from legal to illegal (Chimeli and Soares, 2017) – our results have much lower magnitude.

cation, we restrict the sample to municipalities reporting positive counts of homicides in all years. (panel (c)). Finally, we winsorize data by limiting extreme values to the 5th and 95th percentiles (panel (d)). All the results obtained from these alternative specifications are quantitatively similar to our main results. As deaths due to alcoholic liver diseases are also rare events, Appendix Figure A.13 depicts a similar exercise that confirms the stability of the results under alternative specifications.

6.2 Placebo Outcomes

One concern regarding the effects we find is that the presence of CAPS could be related to other programs or socioeconomic shocks that might also affect our main outcomes. Indeed, Brazil experienced a period of significant economic growth during the 2000s and, concomitantly, saw other important public policies like the *Bolsa Família* and the Family Health Programs be created or expand substantially. However, none of the other public policies in place during the period were directed specifically at mental health and economic shocks will not only affect mental health indicators. Hence, we can use the proposed estimation strategy to run placebo tests on other outcomes aside from mental health indicators and homicides, but related to these other policies and economic conditions, to assess whether the effects we find are due to confounders or not.

Appendix Figure A.14 presents the CAPS' effects on placebo outcomes. Panels (a) and (b) depict that results on socio-economic indicators measured by GDP per capita and PBF spending per capita.[23] We also investigate a few health outcomes. Previous research has shown that other health policies expanded or implemented during the 2000s significantly affected inputs in the production function of infant health

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[23]PBF spending should be based on the number of poor families in each municipality.

and infant mortality (Carrillo and Feres, 2019; Bhalotra et al., 2019; Macinko et al., 2007). Then, panel (c) investigates the CAPS' effects on infant mortality. Previous articles has also shown that other Brazilian policies significantly affected hospitalizations and mortality rates caused by sensitive conditions to primary care (Rocha and Soares, 2010; Fontes et al., 2018; Hone et al., 2020). Following Malta et al. (2007), we thus select avoidable causes of deaths due to interventions in the Brazilian primary care system that do not include mental health complications. In particular, we evaluate vaccine-preventable diseases like Tuberculosis and Hepatitis B, and infectious diseases such as HIV/AIDS and influenza (panel d). Finally, in panel (e), we check whether the pattern of our results on homicides could be explained by local shocks on violent causes of death reflecting, for example, increased urbanization. To do so, we investigate another major cause of violent death: car accidents.

Overall, we do not find any correlation between CAPS' presence and the aforementioned variables, which further suggests that the effects we find are indeed due to the CAPS.

6.3 Compositional Effects

A potential challenge to the interpretation of our estimates, especially the duration effects, relates to compositional effects. For 35 per cent of our treated units, the data contain less than five post-intervention years. Under selective treatment timing, the dynamic effects from early-treated cities may not be representative for the longer-run effects from municipalities with missing post-CAPS data. We then re-estimate our main results using a restricted sample that includes only treated municipalities with at least five years of exposure to treatment. If anything, our results become even more pronounced within this selected sample (see

Appendix Table A4). Estimates still indicate that CAPS increased utilization of mental health outpatient care, reduced hospitalization rates due to mental illness, reduced alcohol-related deaths, but increased homicide rates. Taken together, these results indicate that compositional changes do not explain the pattern of our results.

6.4 Displacement or Spillover Effects

A potential concern with our empirical strategy is on whether displacement or spillover effects could be relevant for our main results. Figure A.15 comparing means for treated and non-treated units over event-times help to address this concern. To construct such time series we first stack residualized (state×year fixed effects) long-differences of the outcome (relative to event-time -1) for each treated cohort and its respective control group. We then collapse data at the event-time using weighted averages based on the treated cohort size. If the aforementioned concern is a problem, we should see at least part of the effect we estimate coming from non-treated units breaking the trend in which they were. However, what Figure A.15 depicts is that, when treated units are treated, they are the only ones that break the trend, while non-treated units continue in the same trend they were, which is consistent with no displacement effects.

7 Conclusion

This paper studies the Brazilian psychiatric reform, which reorganized mental health care provision by the public system building a network of community-based services centered on Psychosocial Care Centers (CAPS). To identify the causal effects of this reform, we exploit municipality-level

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variation in the CAPS' establishment. We find that the reform increased access and utilization of ambulatory mental health care and reduced hospitalizations due to mental and behavioral disorders. Those reductions were more pronounced for long-stay admissions and among patients with schizophrenia. We additionally show that the centers delivering substance abuse treatment reduced deaths due to alcoholic liver diseases. Despite those positive effects, we also find an increase in homicide rates, potentially caused by the incapacitation effects long-stay hospitalizations have on crime-prone mentally ill. To the best of our knowledge, this paper provides the first causal evaluation of a large-scale mental-health reform. Our estimates are thus particularly informative for many countries facing significant deficits in the provision of mental health treatments (WHO, 2013) and countries developing or revising deinstitutionalization interventions, which, according to the UN (2020), should be a priority following the Covid-19 pandemic.

Our results support the view there are significant trade-offs to be considered when choosing the optimal delivery of mental healthcare (Lamb, 2015). While it is outside the scope of this paper to uncover the pitfalls of community care compared with other forms of care, there are a few particularities of our context worth mentioning. The deinstitutionalization process in Brazil occurred late and still needs investment. Less than three percent of Brazilian municipalities have access to mental health centers that serve the population 24 hours a day and have outpatient beds and crisis intervention services. However, such infrastructure is seen as fundamental to reducing violence by people with serious mental illness in the community (Thornicroft and Tansella, 2013; Lamb and Weinberger, 2005; Dvoskin and Steadman, 1994). Therefore, incorporating intensive care models into the community settings, as some countries have recently done (Adamou, 2005), can be a way of improving policy

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outcomes of mental-health reforms. Evaluating these interventions is left to future work.

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Tables and Figures

Figure 1: Number of municipalities receiving a CAPS (of all types) by year
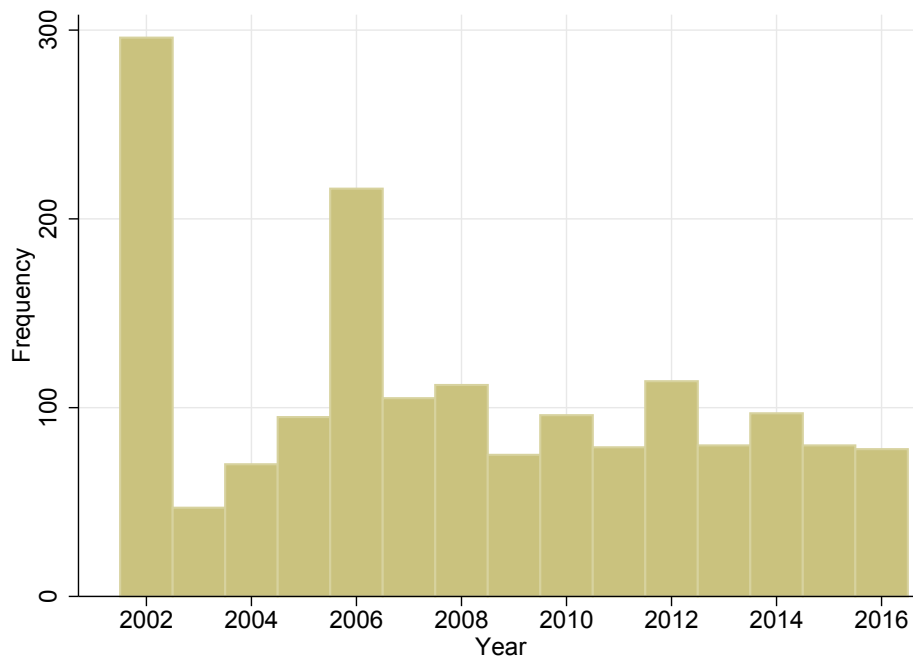
Notes: This graph plots the number of municipalities receiving a CAPS for the first time from 2002 to 2016. A number of CAPS were created before the period and were accredited in 2002, explaining the spike in 2002. For the remaining CAPS, the accreditation coincides with opening. This data show the first date of accreditation, or date of CAPS' opening for the vast majority.

Figure 2: The effects of CAPS on psychosocial care procedures – 02-16
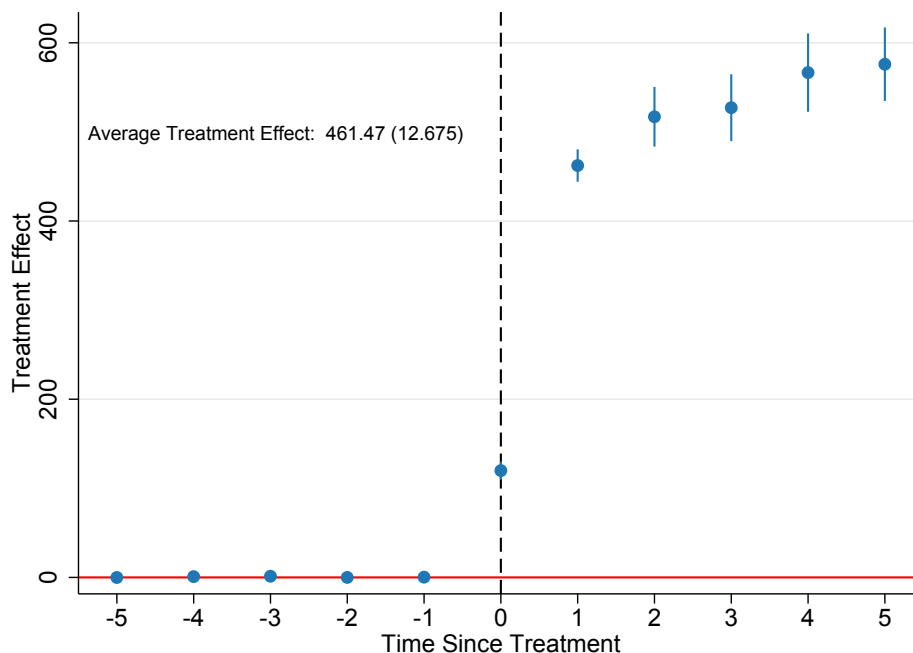
Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of psychosocial care procedures, which are the ambulatory services provided at the CAPS. The Average Treatment Effect computes a simple average of the instantaneous and dynamic effects. In parenthesis, standard errors computed with a municipality-level clustered boot-strap.

Figure 3: Effects of CAPS on mental health practitioners – 08-16
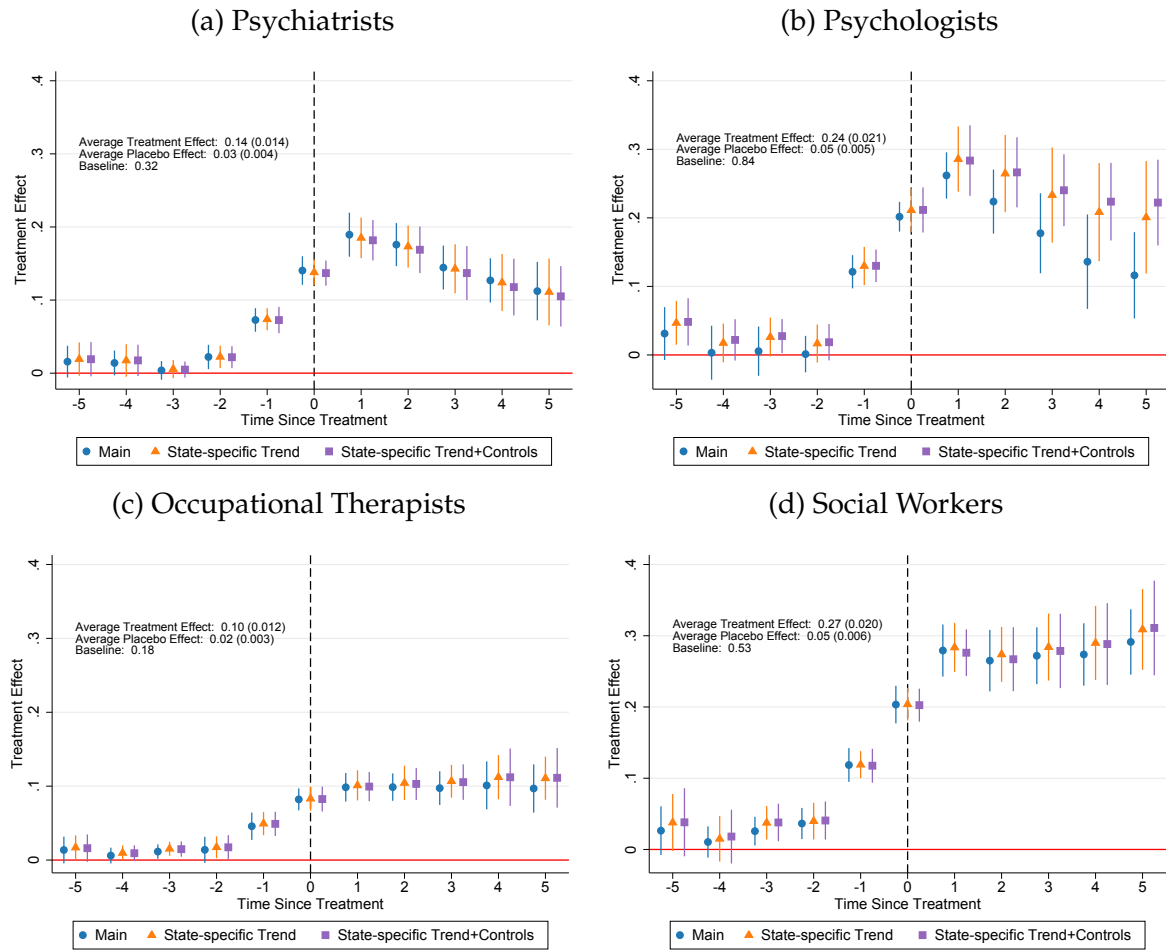
(a) Psychiatrists

(b) Psychologists

(c) Occupational Therapists

(d) Social Workers

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of mental health practitioners. Result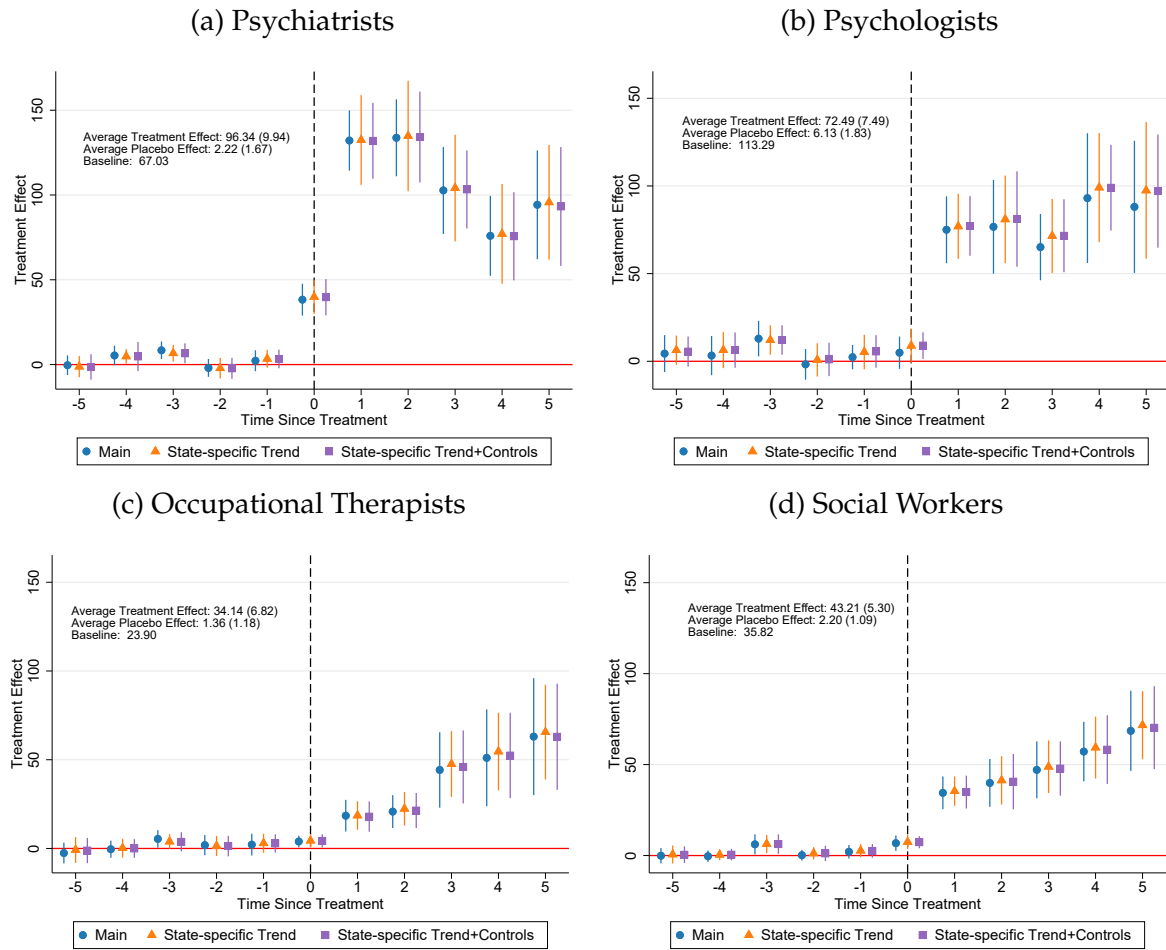s for the three different specifications considered are shown, as indicated in the graph. In the first specification, we do not include any controls. In the second specification, controls include a set of state×year indicators. In the third specification, it further include municipality GDP per capita, PBF speding per capita, and a series of indicators for age-by-gender population bins. The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

Figure 4: Effects of CAPS on outpatient care by mental health specialists – 08-16

(a) Psychiatrists

Average Treatment Effect: 96.34 (9.94)
Average Placebo Effect: 2.22 (1.67)
Baseline: 67.03

Main   State-specific Trend   State-specific Trend+Controls

(b) Psychologists

Average Treatment Effect: 72.49 (7.49)
Average Placebo Effect: 6.13 (1.83)
Baseline: 113.29

Main   State-specific Trend   State-specific Trend+Controls

(c) Occupational Therapists

Average Treatment Effect: 34.14 (6.82)
Average Placebo Effect: 1.36 (1.18)
Baseline: 23.90

Main   State-specific Trend   State-specific Trend+Controls

(d) Social Workers

Average Treatment Effect: 43.21 (5.30)
Average Placebo Effect: 2.20 (1.09)
Baseline: 35.82

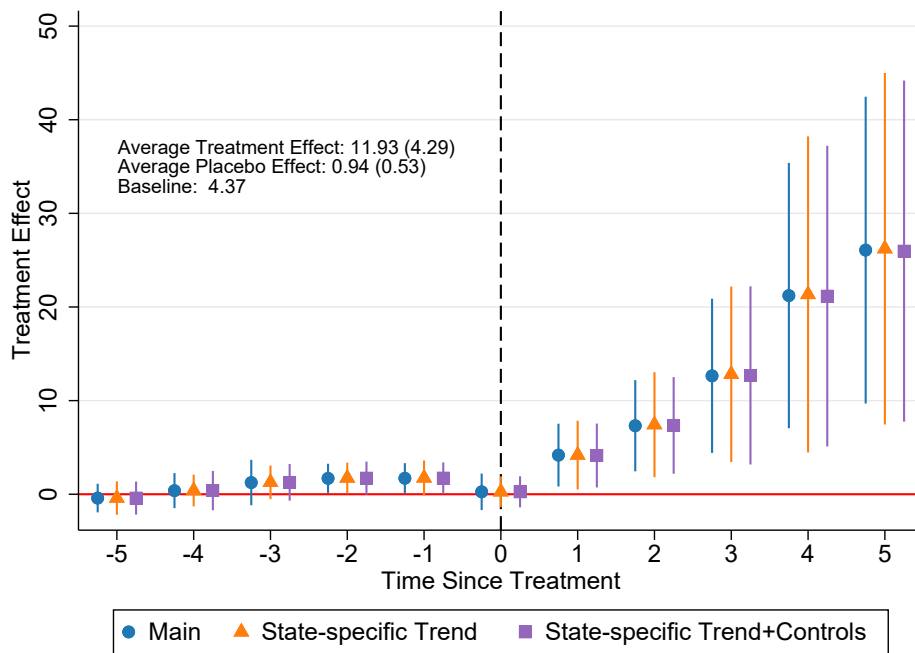Main   State-specific Trend   State-specific Trend+Controls

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of ambulatory procedures made by mental health providers. For additional details, see Figure 3.

Figure 5: Effects of CAPS on dispensed antipsychotic drugs – 08-16

Average Treatment Effect: 11.93 (4.29)
Average Placebo Effect: 0.94 (0.53)
Baseline: 4.37

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of dispensed antipsychotic drugs. These are drugs delivered at the ambulatory level for patients, especially with schizophrenia and other psychotic disorders, for home use. For additional details, see Figure 3.

Figure 6: Effects of CAPS on psychiatric beds – 06-16

Average Treatment Effect: 0.07 (0.217)
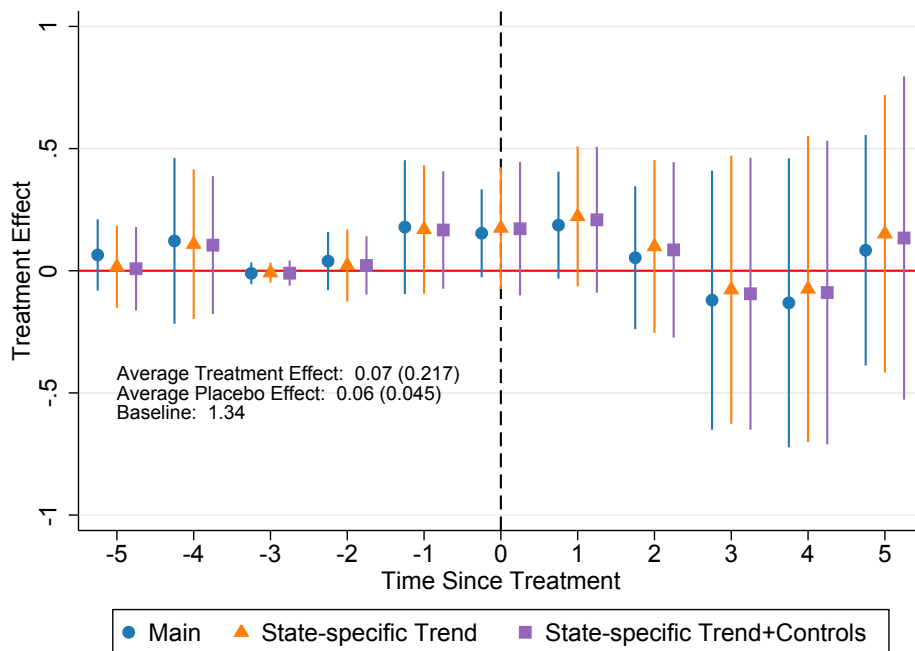Average Placebo Effect: 0.06 (0.045)
Baseline: 1.34

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of psychiatric beds. For additional details, see Figure 3.

Figure 7: Effects of CAPS on hospitalizations due to mental and behavioral disorders – 02-16

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of hospital admissions due to mental and behavioral disorders (ICD-10 F00-F99). For additional details, see Figure 3.

Figure 8: Effects of CAPS on long-stay hospitalizations due to mental and behavioral disorders (>30 days) – 02-16
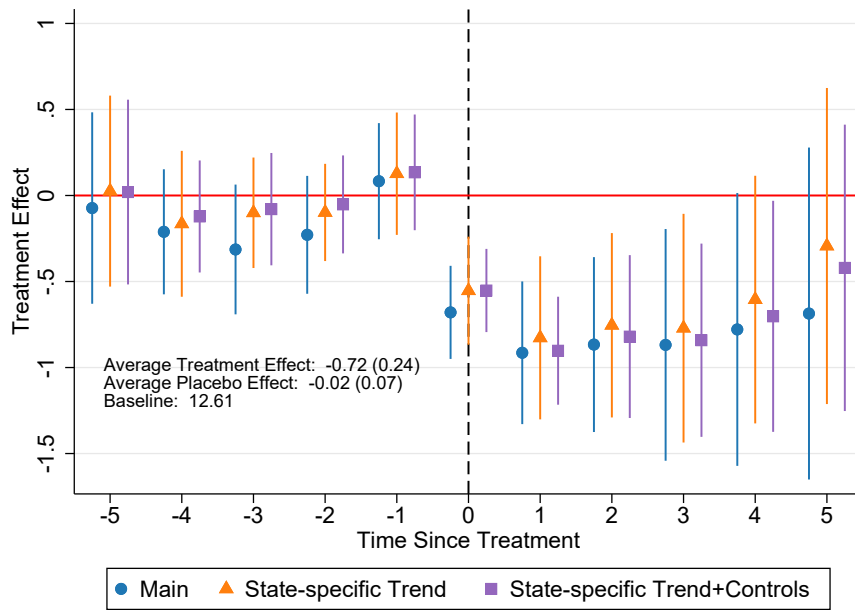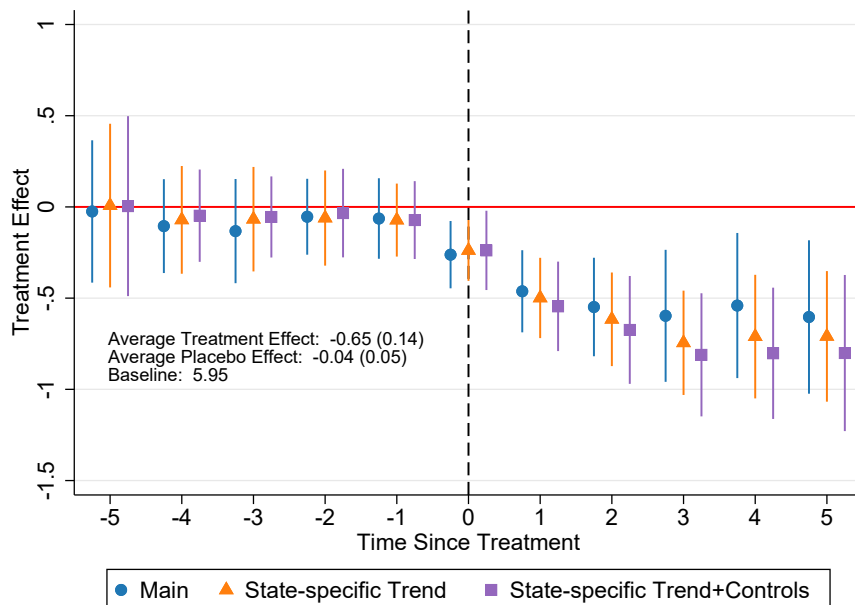

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of long-stay hospital admissions due to mental and behavioral disorders (ICD-10 F00-F99). Long-stay hospitalizations are defined as those in which the patient is hospitalized for more than 30 days. For additional details, see Figure 3.

Figure 9: Effects of CAPS on hospitalization by cause – 02-16

(a) Schizophrenia and Related Disorders
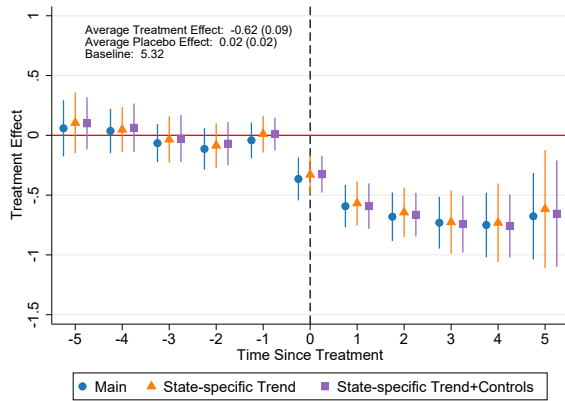
Average Treatment Effect: -0.62 (0.09)
Average Placebo Effect: 0.02 (0.02)
Baseline: 5.32

(b) Mood Disorders

Average Treatment Effect: -0.09 (0.080)
Average Placebo Effect: 0.01 (0.018)
Baseline: 1.64

(c) Neurotic and Stress-related Disorders

Average Treatment Effect: 0.00 (0.009)
Average Placebo Effect: -0.00 (0.004)
Baseline: 0.11

(d) Psychoactive Substance Abuse Disorders

Average Treatment Effect: 0.13 (0.159)
Average Placebo Effect: -0.02 (0.042)
Baseline: 4.29

(e) Mental Retardation

Average Treatment Effect: -0.01 (0.017)
Average Placebo Effect: -0.01 (0.025)
Baseline: 0.24
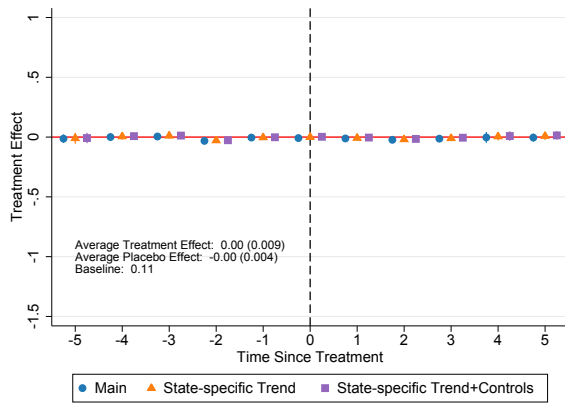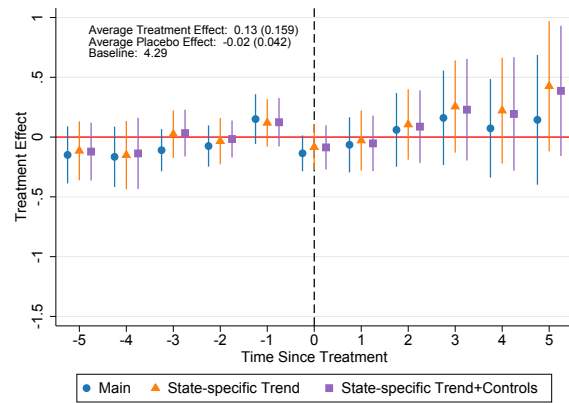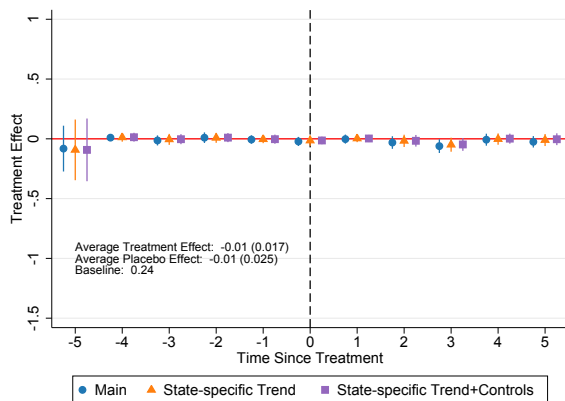
(f) Dementia and other Organic Disorders
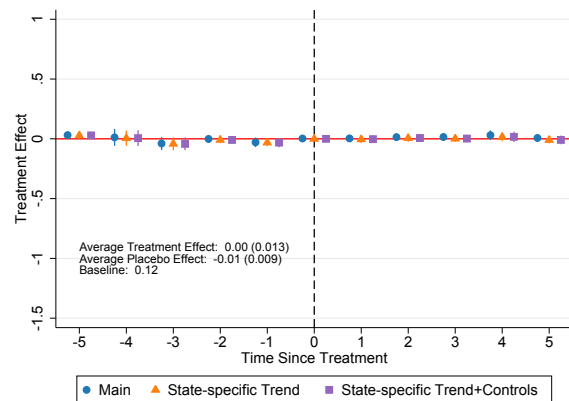
Average Treatment Effect: 0.00 (0.013)
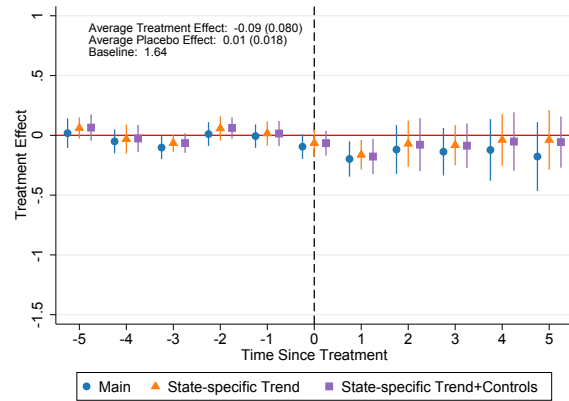Average Placebo Effect: -0.01 (0.009)
Baseline: 0.12

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of hospital admissions due to mental and behavioral disorders by groups of cause: schizophrenia and related disorders (F20-F29), mood disorders (F30-F39), substance abuse disorders (F10-F19), mental retardation (F70-79), and organic disorders (F00-F09). For additional details, see Figure 3.

Figure 10: Effects of CAPS on mortality by cause – 02-16
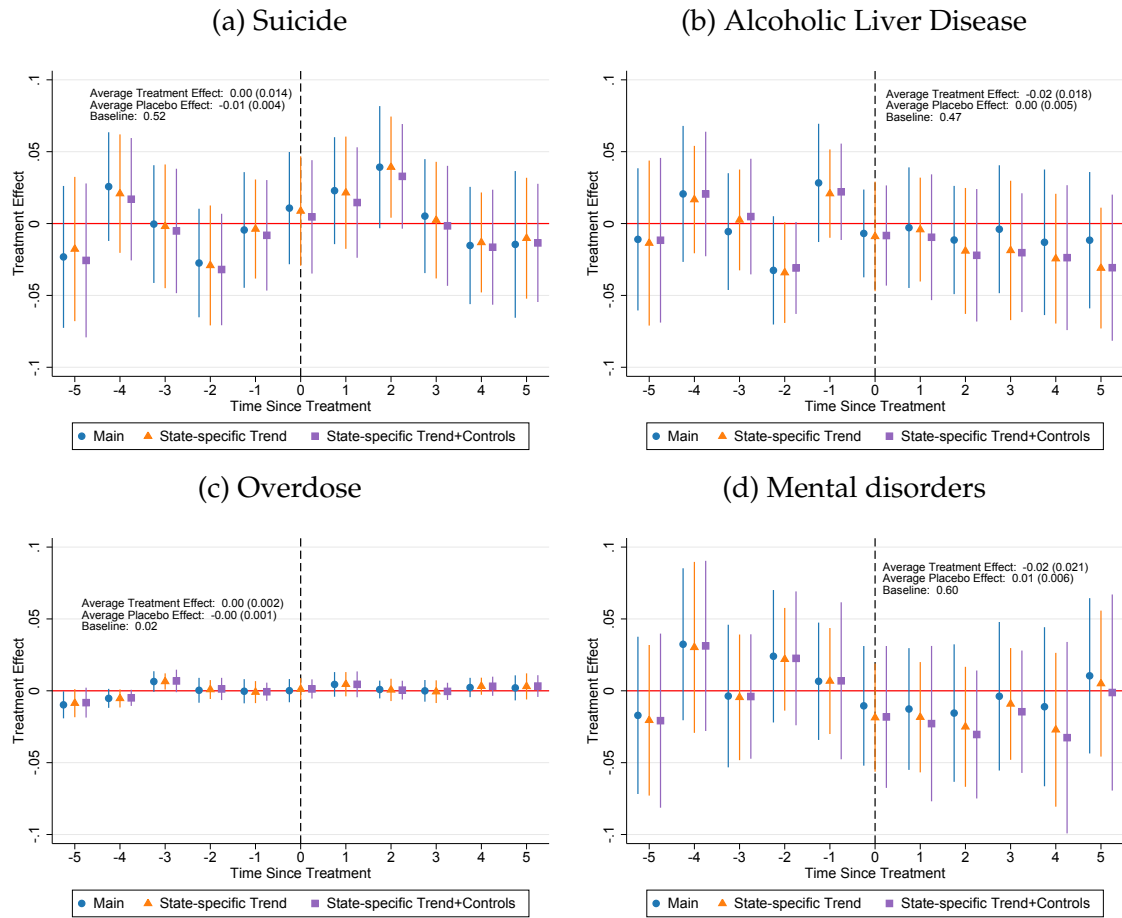
(a) Suicide

(b) Alcoholic Liver Disease

(c) Overdose

(d) Mental disorders

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of mortality due to m suicide (X60-X84), alcoholic liver disease (K70, K73-K74), overdose (X40-X45, Y10-Y15, Y45, Y47, Y49), and mental disorders (F00-F99). For additional details, see Figure 3.

Figure 11: Effects of CAPS AD on substance-abuse-related deaths – 02-16

(a) Self-inflicted Poisoning and Overdose

Average Treatment Effect: 0.01 (0.008)
Average Placebo Effect: 0.00 (0.003)
Baseline: 0.09

● Main ▲ State-specific Trend ■ State-specific Trend+Controls

(b) Alcoholic Liver Disease

Average Treatment Effect: -0.05 (0.02)
Average Placebo Effect: -0.01 (0.00)
Baseline: 0.49

● Main ▲ State-specific Trend ■ State-specific Trend+Controls

(c) Psychoactive Substance Abuse Disorders

Average Treatment Effect: 0.03 (0.032)
Average Placebo Effect: 0.01 (0.006)
Baseline: 0.64

● Main ▲ State-specific Trend ■ State-specific Trend+Controls
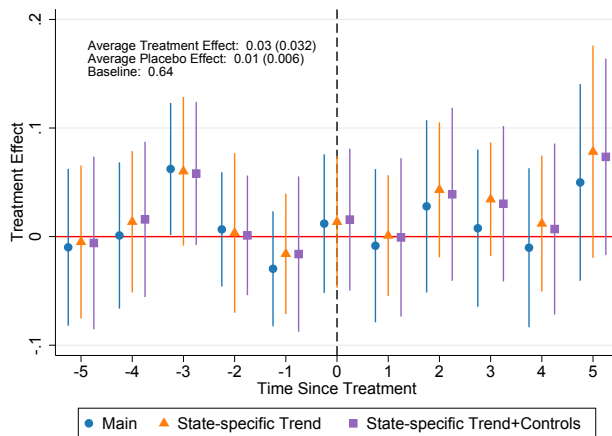
Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS AD effects on the rate of deaths caused by self-inflicted poisoning and overdose (X60-X69, X40-X45, Y10-Y15, Y45, Y47, Y49), alcoholic liver disease (K70), and psychoactive substance abuse disorders (F10-F19). For additional details, see Figure 3.

Figure 12: Effects of CAPS on homicides – 02-16

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of homicide (X85-Y09). For additional details, see Figure 3.

Figure 13: Effects of CAPS on hospitalization by cause – 02-16 – São Paulo
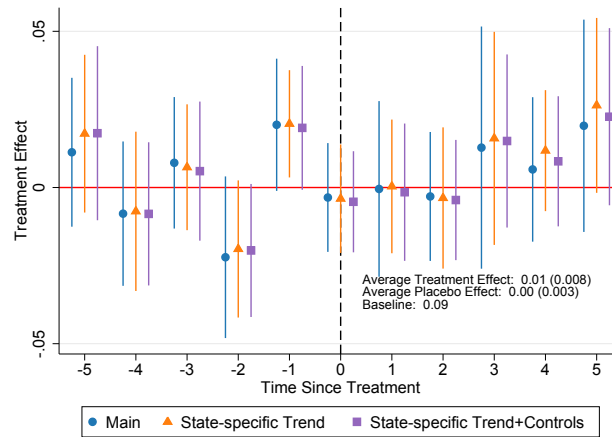
(a) Mental and Behavioral Disorders

Average Treatment Effect: 1.34 (2.261)
Average Placebo Effect: 0.76 (0.581)
Baseline: 24.71 (26.402)

(b) Schizophrenia and Related Disorders

Average Treatment Effect: -0.86 (0.810)
Average Placebo Effect: 0.55 (0.294)
Baseline: 8.21 (8.896)

(c) Long-stay hospitalizations (>30 days)

Average Treatment Effect: -1.60 (1.651)
Average Placebo Effect: 1.39 (0.470)
Baseline: 11.28 (16.357)

(d) Psychoactive Substance Abuse Disorders

Average Treatment Effect: 2.28 (0.992)
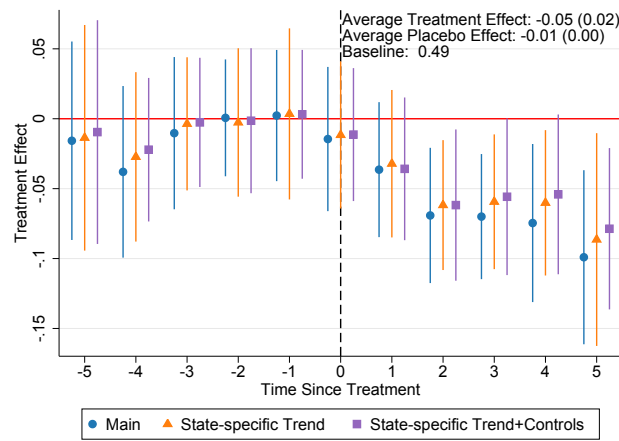Average Placebo Effect: -0.03 (0.393)
Baseline: 9.87 (12.094)

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on hospitalization rates related to mental and behavioral disorders, schizophrenia, drug- and alcohol-related hospitalizations, and long-stay admissions. The Average Treatment Effect computes a simple average of the instantaneous and dynamic effects. In parenthesis, standard errors computed with a municipality-level clustered boot-strap.
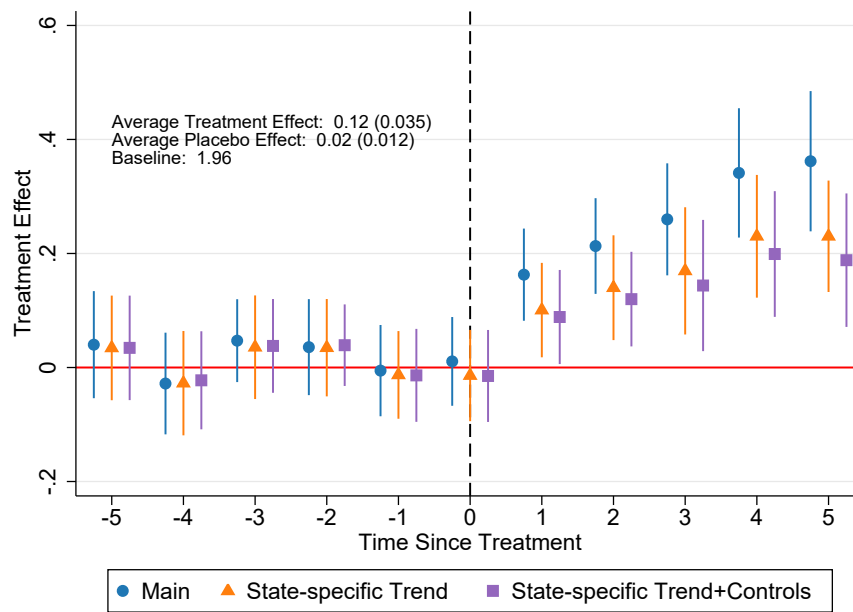
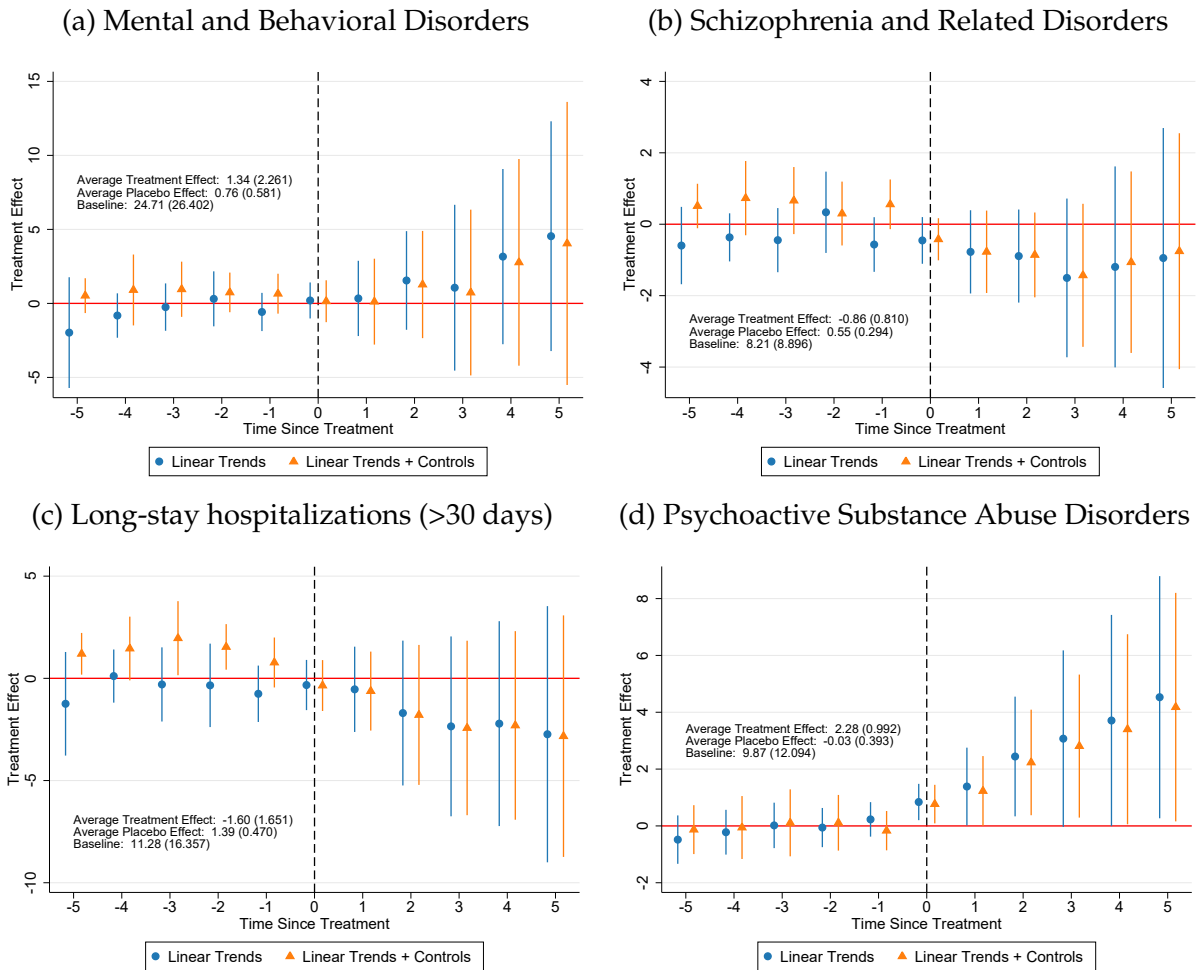Figure 14: Effects of CAPS on homicides and crime measures – 02-16 – São Paulo
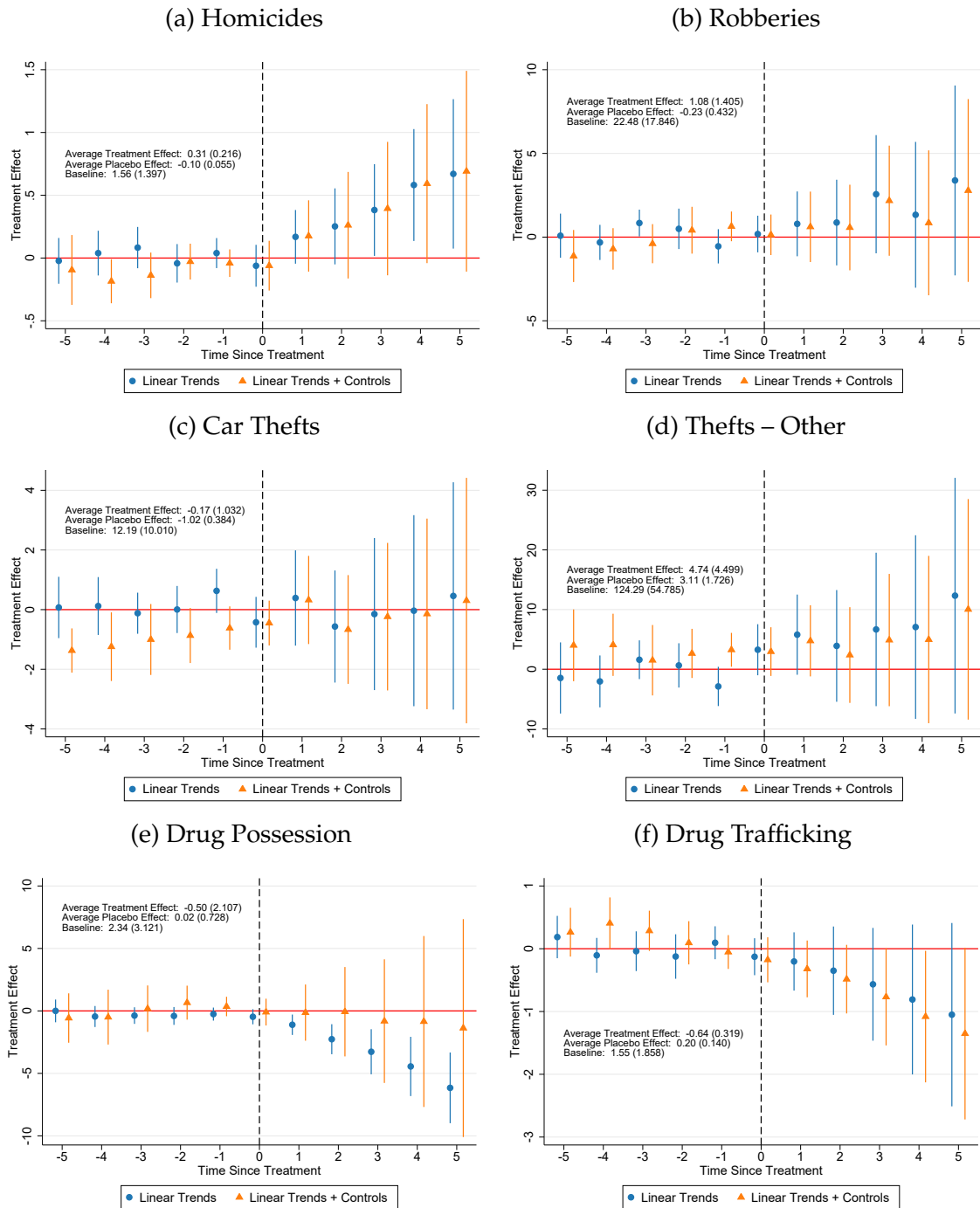
Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on homicide rates and crime measures. In parenthesis, standard errors computed with a municipality-level clustered boot-strap.

Online Appendice

For online publication.

A   Additional Figures and Tables

Figure A.1: Number of municipalities adopting CAPS (by CAPS' types) by year

(a) CAPS I

(b) CAPS II

(c) CAPS III

(d) CAPS AD

(e) CAPS AD III

(f) CAPS Inf
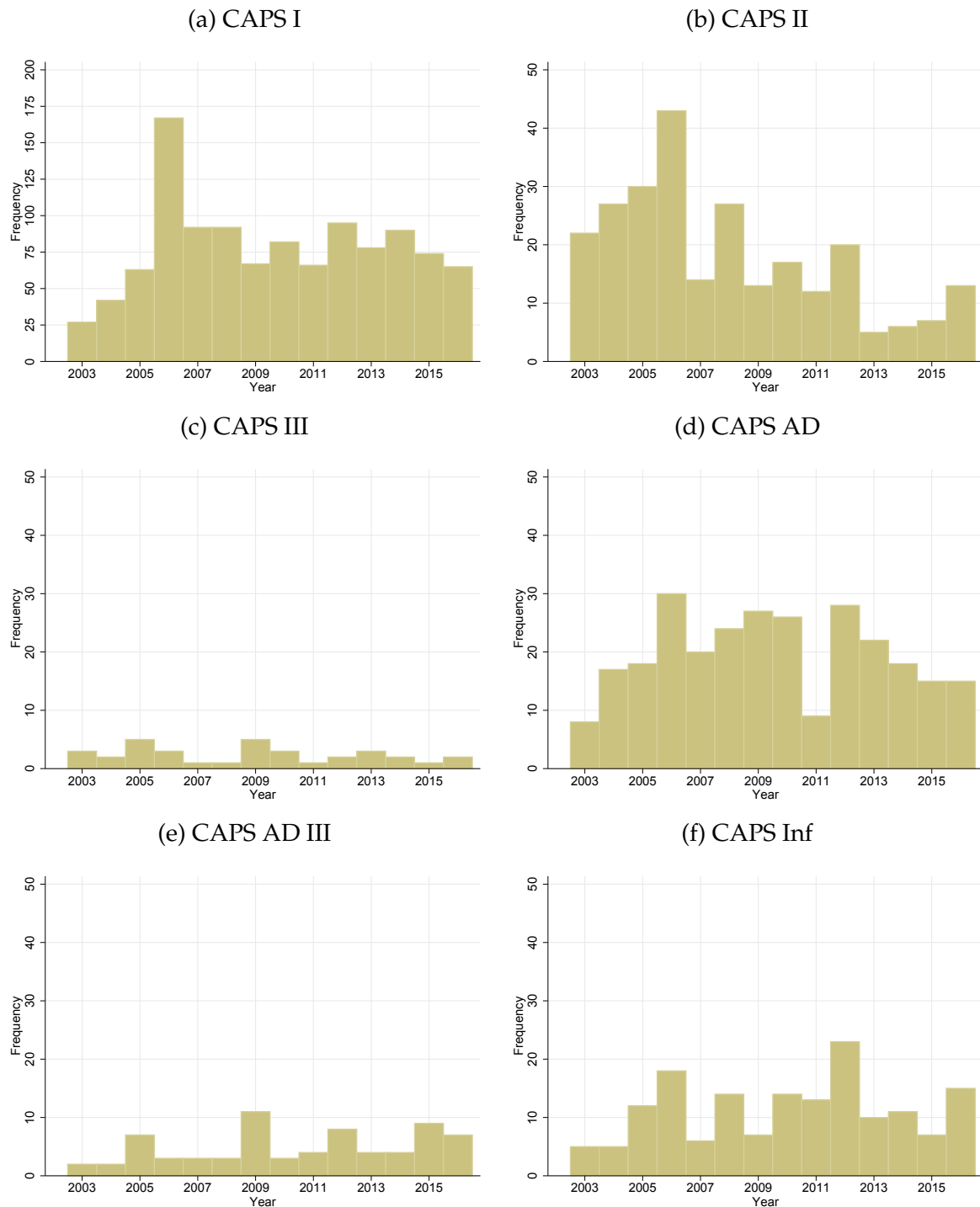
Notes: These graphs plot the number of municipalities receiving a CAPS for the first time, by CAPS' type, from 2003 to 2016. Due to the discrepancy between the number of municipalities receiving a CAPS I and other types, panel (a) uses a different scale. We omit 2002 as we cannot distinguish municipalities that got a CAPS in 2002 from those that got earlier. This data show the first date of accreditation, or date of CAPS' opening for the vast majority.

Figure A.2: Fraction of treated municipalities by the number of adopted CAPS
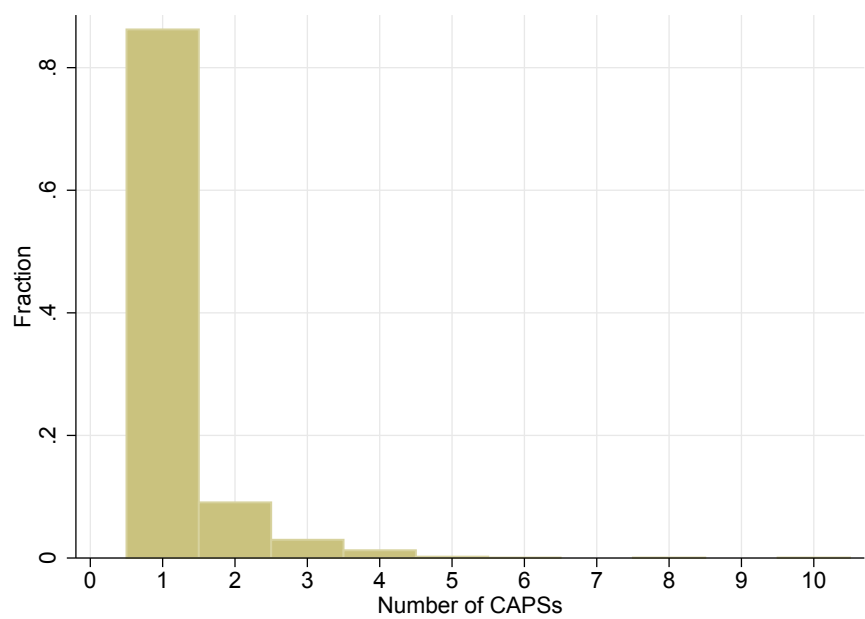
Notes: Among the municipalities that have adopted a CAPS starting in 2003, this graph plots the fraction by the number of opened centers.

Figure A.3: The effects of CAPS on psychosocial care procedures by type of care– 02-12

(a) Non-intensive care (monthly visits)
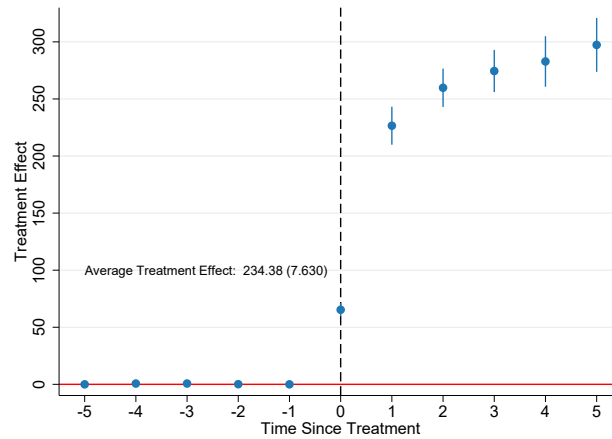
(b) Semi-intensive care (weekly visits)
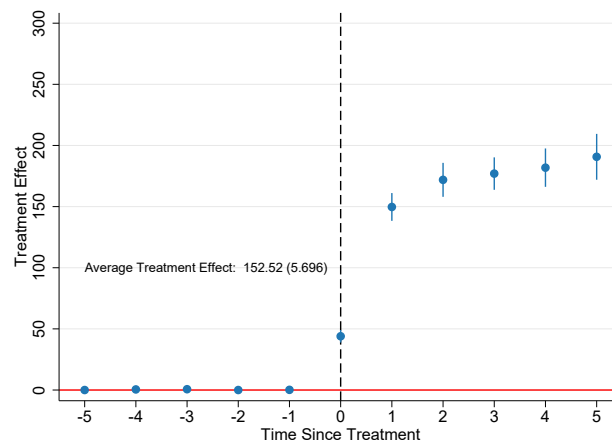

(c) Intensive care (daily visits)
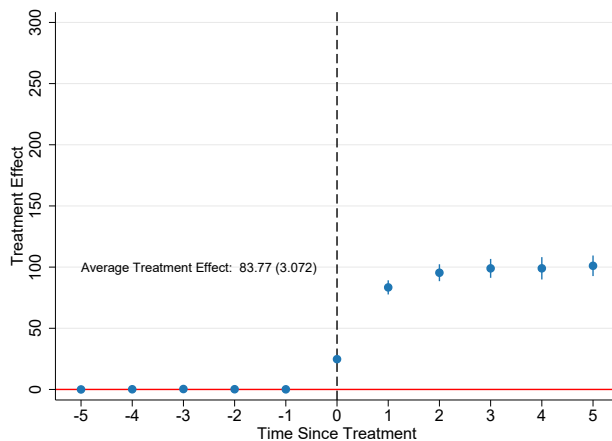
Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of psychosocial care procedures by type of care. Until 2012, the provided care were labeled as non-intensive – for patients needing monthly assistance, semi-intensive – for weekly visits, and intensive – for patients with almost daily care. The Average Treatment Effect computes a simple average of the instantaneous and dynamic effects. In parenthesis, standard errors computed with a municipality-level clustered boot-strap.

Figure A.4: The effects of CAPS on psychosocial care procedures by groups of cause– 02-12

(a) Schizophrenia and Related Disorders

(b) Mood Disorders

(c) Neurotic and Stress-Related Disorders

(d) Psychoactive Substance Abuse Disorders

(e) Mental Retardation

(f) Organic Disorders

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of psychosocial care procedures by groups of cause. The Average Treatment Effect computes a simple average of the instantaneous and dynamic effects. In parenthesis, standard errors computed with a municipality-level clustered boot-strap.

Figure A.5: Effects of CAPS on therapeutic workshops – 02-16

Average Treatment Effect: 0.69 (0.126)
Average Placebo Effect: 0.00 (0.022)
Baseline: 1.15

● Main ▲ State-specific Trend ■ State-specific Trend+Controls

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of therapeutic workshops. The same specifications from Figure 3 also apply here. The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered boot-strap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

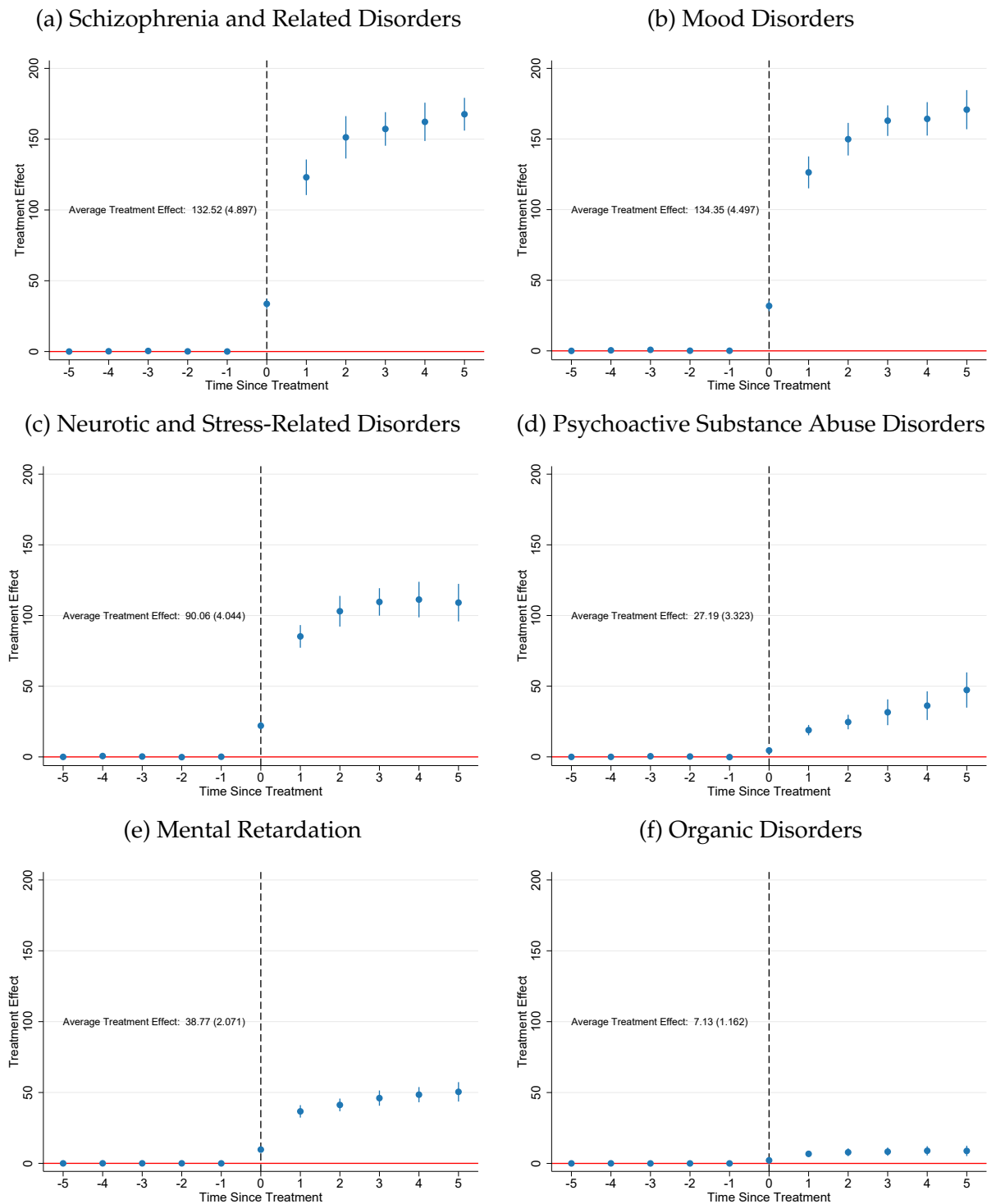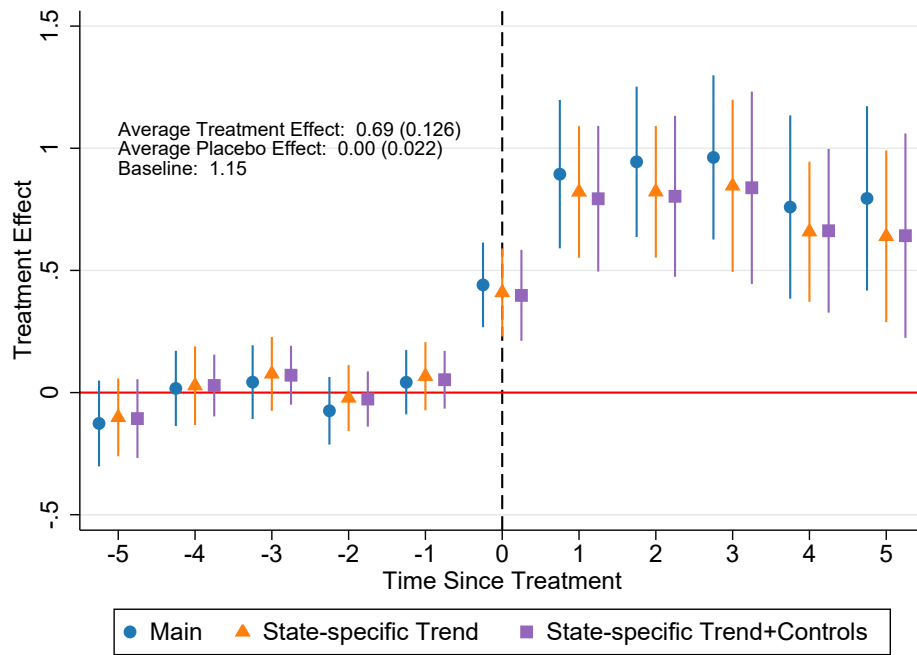Figure A.6: Effects of CAPS AD on psychosocial care procedures related to psychoactive substance abuse disorders – 02-12

This figure plots 95% confidence-intervals computed with a municipality-level clustered boot-strap and dynamic and placebo DID estimators for the CAPS AD effects on the rate of psychosocial care procedures related to psychoactive substance abuse disorders. The Average Treatment Effect computes a simple average of the instantaneous and dynamic effects. In parenthesis, standard errors computed with a municipality-level clustered boot-strap.

Figure A.7: Effects of CAPS AD on hospitalizations due to psychoactive substance abuse disorders – 02-16

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS AD effects on the rate of hospital admissions due to psychoactive substance abuse disorders (codes F10-F19). The same specifications from Figure 3 also apply here. We additionally control for the introduction of any other type of center. The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

Figure A.8: Effects of CAPS AD on deaths due to alcoholic and unspecified sources of chronic liver diseases – 02-16
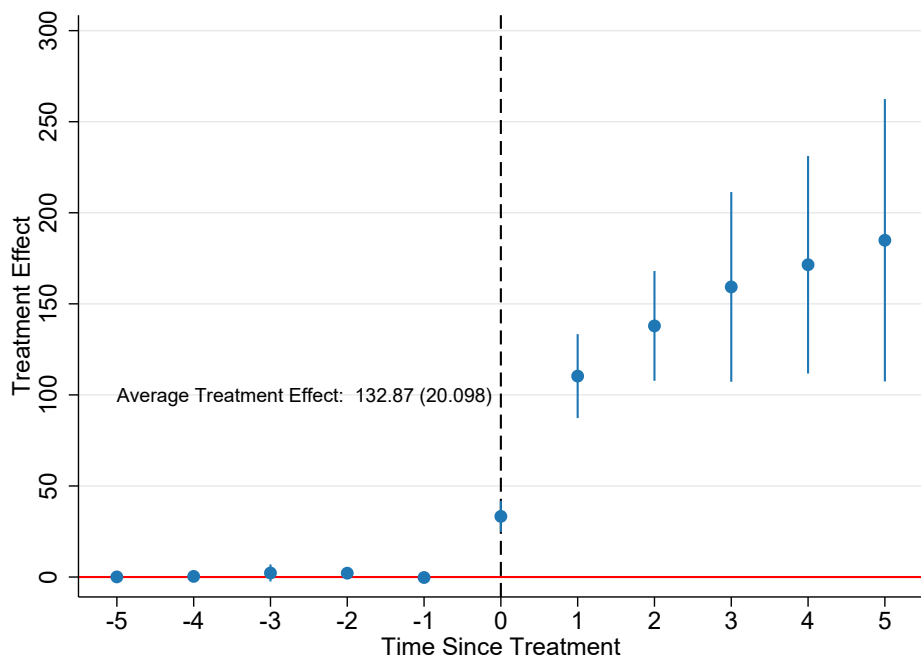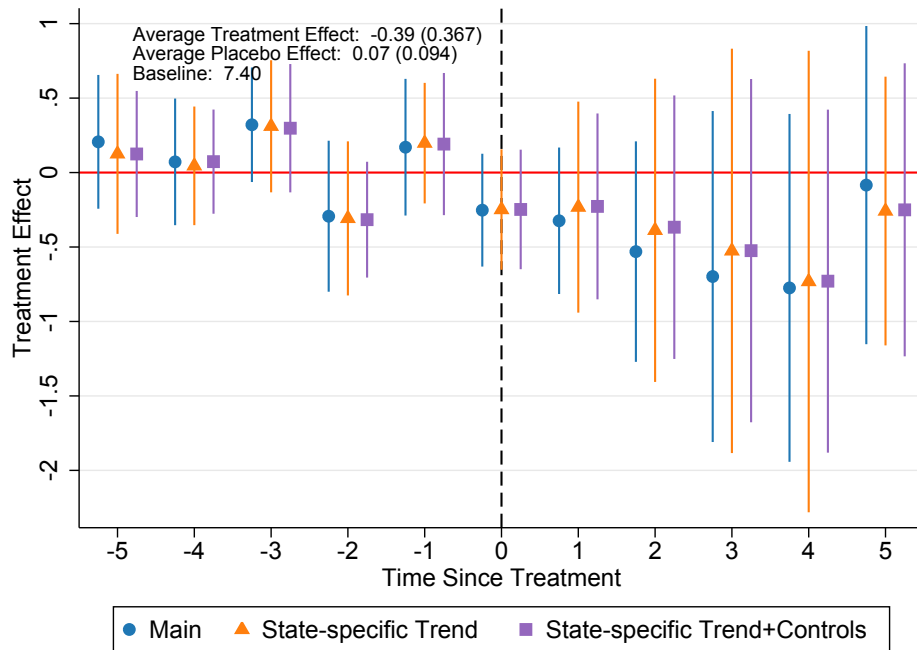

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS AD effects on mortality rates due to alcoholic and unspecified sources of chronic liver diseases (codes K70, K73, K74). The same specifications from Figure 3 also apply here. We additionally control for the introduction of any other type of center. The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

Figure A.9: Effects of CAPS AD on liver transplantation rate – 02-16

(a) Liver transplantation

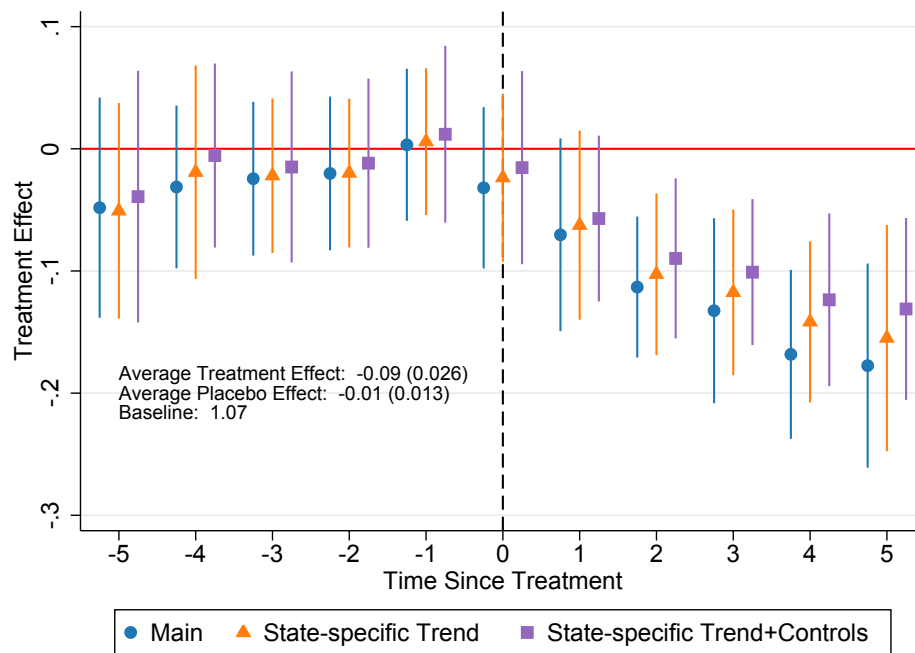## (b) Liver transplantation only to individuals with alcoholic liver disease
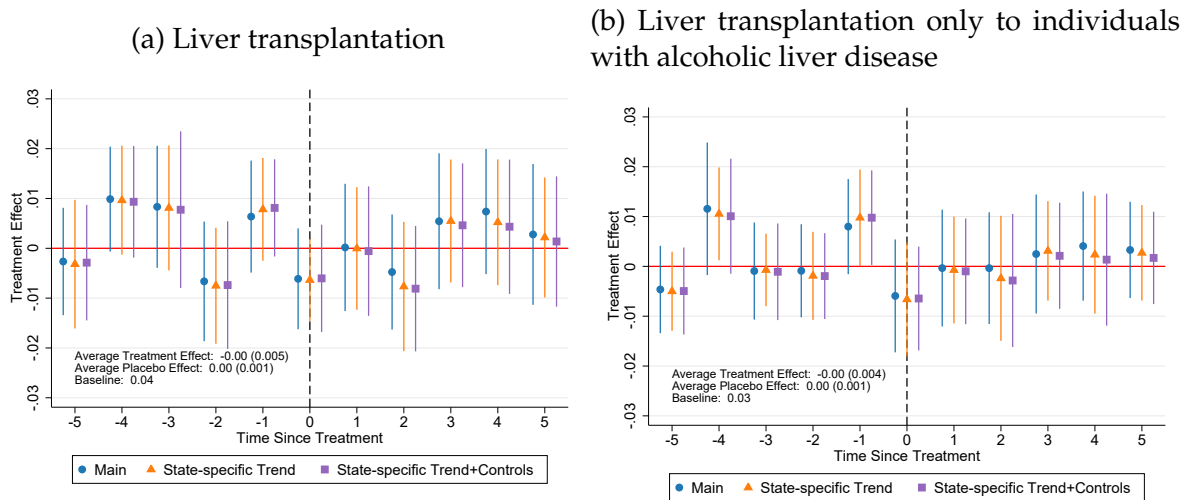

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the Effects of CAPS AD on liver transplantation rate (panel a) and on the rate of liver transplantation performed in individuals with alcoholic liver disease (panel b). The same specifications from Figure 3 also apply here. We additionally control for the introduction of any other type of center. For the third specification, the average effects over the non-placebo even-times are the following. The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

Figure A.10: Average effects of CAPS AD on the rate of deaths caused by alcoholic liver disease – 02-16

(a) Alcoholic liver disease (b) Alcoholic and chronic liver disease

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and the average treatment effect of CAPS AD on deaths due to alcoholic liver disease (panel a; code K70) and alcoholic and unspecified sources of chronic liver diseases (panel b; codes K70, K73, K74). We present the results for different sample restrictions. In particular, we restrict the sample to municipalities above the 10th, 25th, 50th, 75h, and 90th percentile of the population distribution. Average treatment effect is defined by the average of the effects for the non-negative event-times. The same specifications from Figure 3 also apply here. We additionally control for the introduction of any other type of center.

Figure A.11: The effects of CAPS on hospitalization by psychoactive substance abuse disorder by type – 02-16 – São Paulo
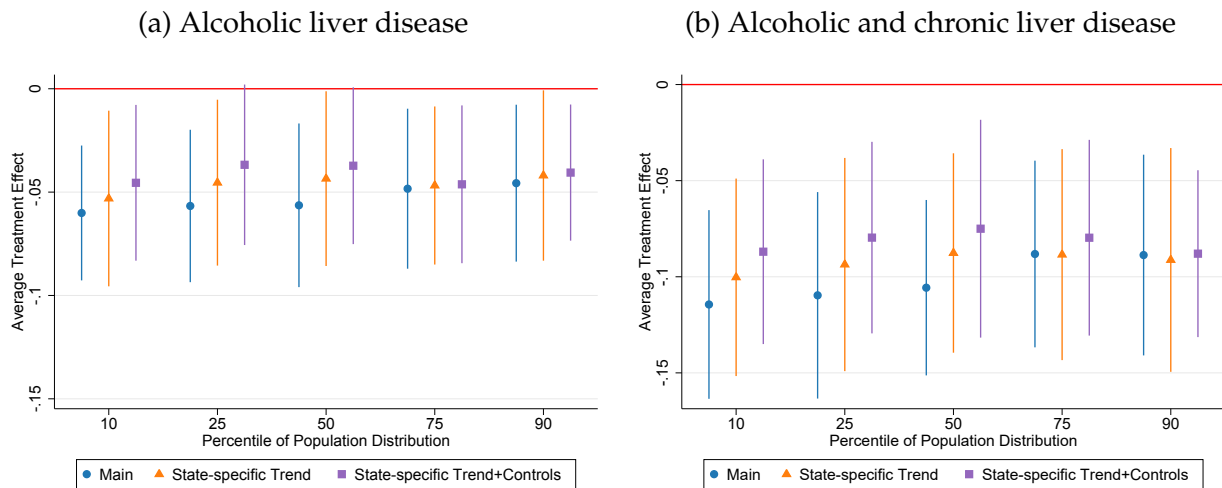
(a) CAPS I

(b) CAPS II

(c) CAPS AD

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of hospitalization related to psychoactive substance abuse disorder by type of CAPS. The Average Treatment Effect computes a simple average of the instantaneous and dynamic effects. In parenthesis, standard errors computed with a municipality-level clustered boot-strap.

Figure A.12: Effects of CAPS on homicide - 02-12

(a) Weighting by population size

Average Treatment Effect: 0.13 (0.042)
Average Placebo Effect: -0.02 (0.017)
Baseline: 1.96

● Main ▲ State-specific Trend ■ State-specific Trend+Controls

(b) Discarding small municipalities

Average Treatment Effect: 0.10 (0.044)
Average Placebo Effect: 0.02 (0.010)
Baseline: 1.88

● Main ▲ State-specific Trend ■ State-specific Trend+Controls

(c) Discarding municipalities with no homicides trough the panel

Average Treatment Effect: 0.12 (0.040)
Average Placebo Effect: 0.01 (0.010)
Baseline: 1.96

● Main ▲ State-specific Trend ■ State-specific Trend+Controls

(d) 90% winsorization

Average Treatment Effect: 0.07 (0.035)
Average Placebo Effect: 0.01 (0.012)
Baseline: 1.88

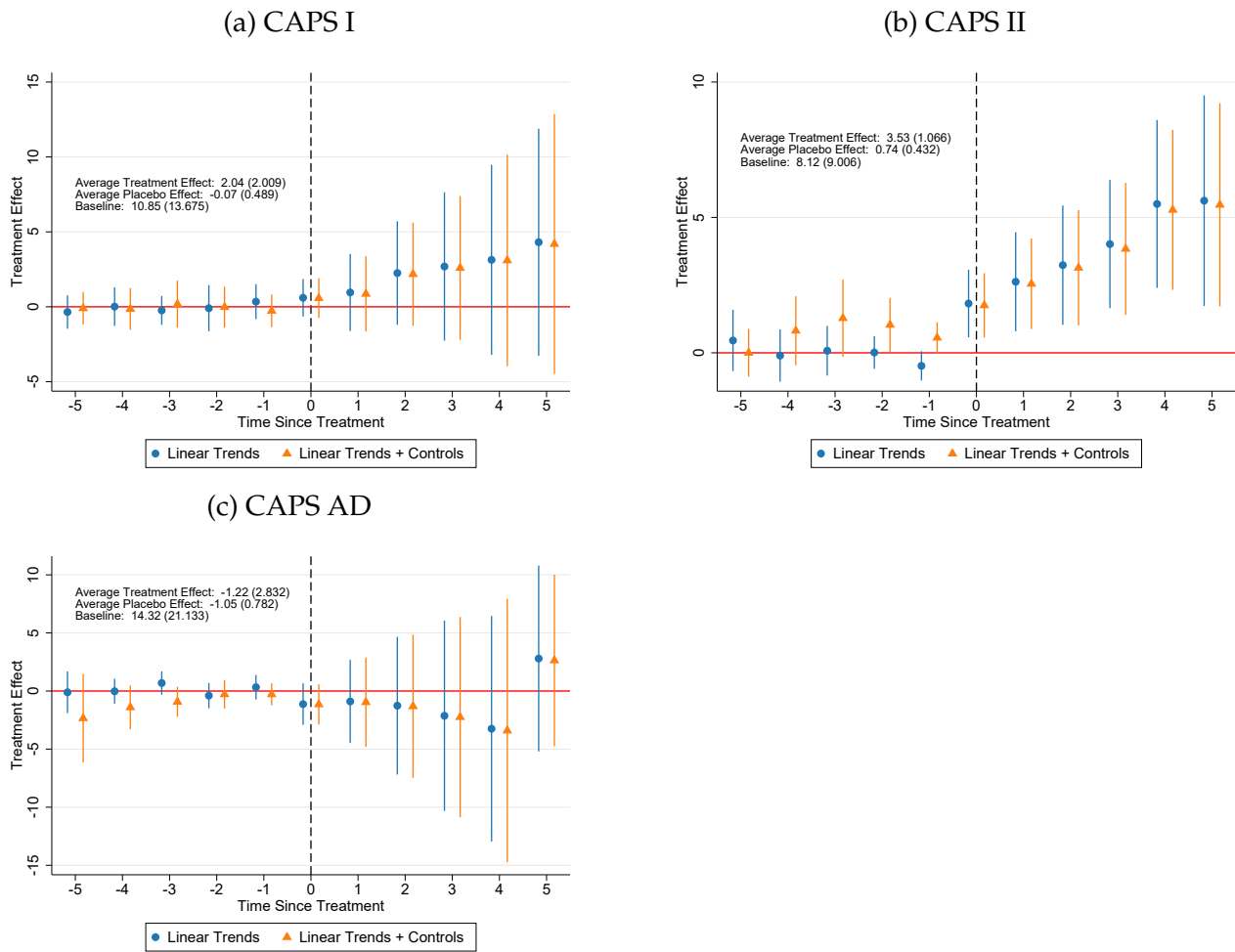● Main ▲ State-specific Trend ■ State-specific Trend+Controls

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on homicides, for different specifications. In panel a, we present estimates weighted by the baseline population size; in panel b, we discard municipalities bellow the 10th percentile of the population size distribution; in panel c, we restrict the sample to municipalities reporting positive counts of homicides rates in all years; and in panel d, we set data below the 5th percentile to the 5th percentile, and set data above the 95th percentile to the 95th percentile. Regarding covariates, the same specifications from Figure 3 also apply here. The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

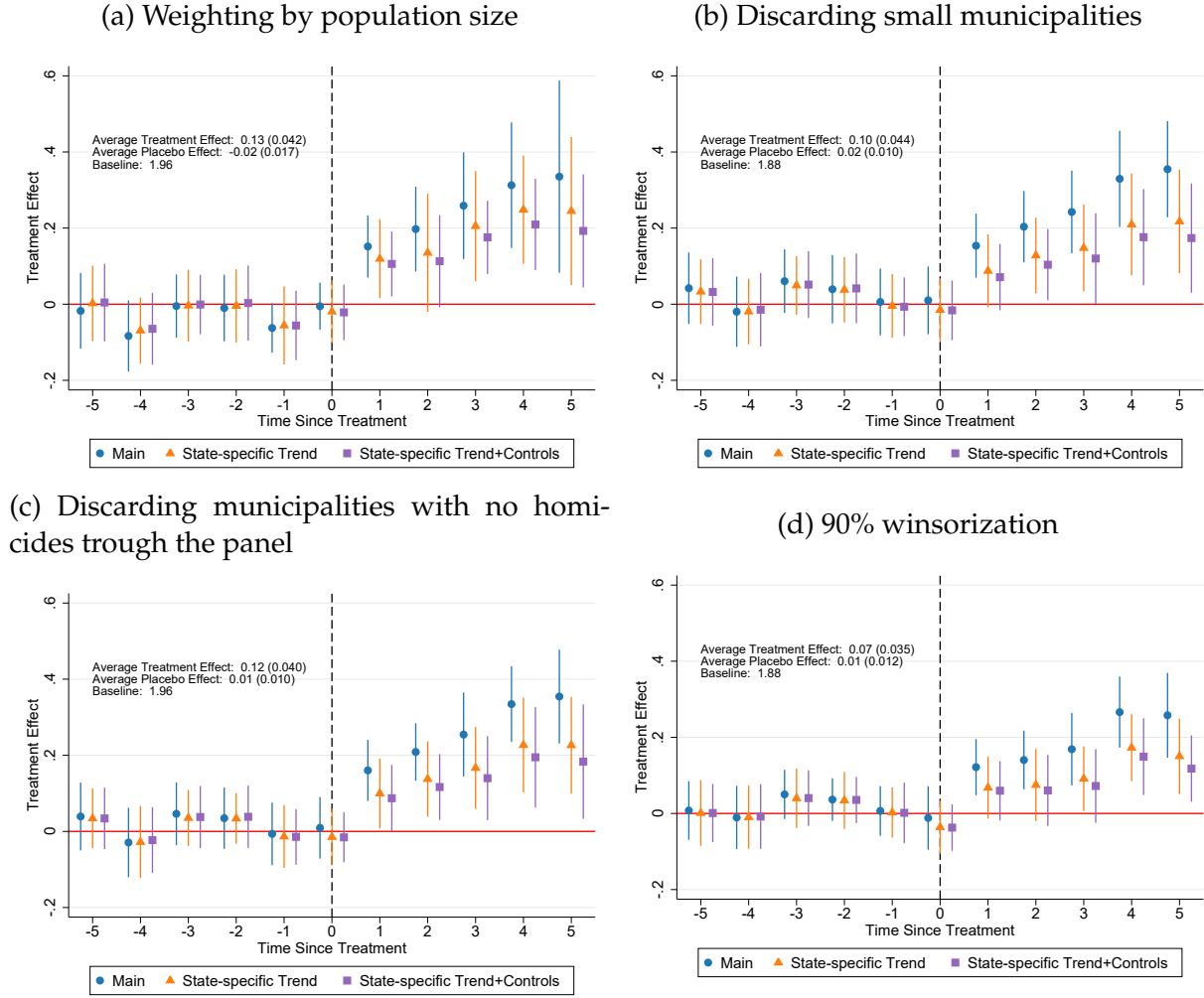Figure A.13: Effects of CAPS AD on the rate of deaths caused by alcoholic liver disease-02-12

(a) Weighting by population size

(b) Discarding small municipalities

(c) Discarding municipalities with no deaths by alcoholic liver disease trough the panel
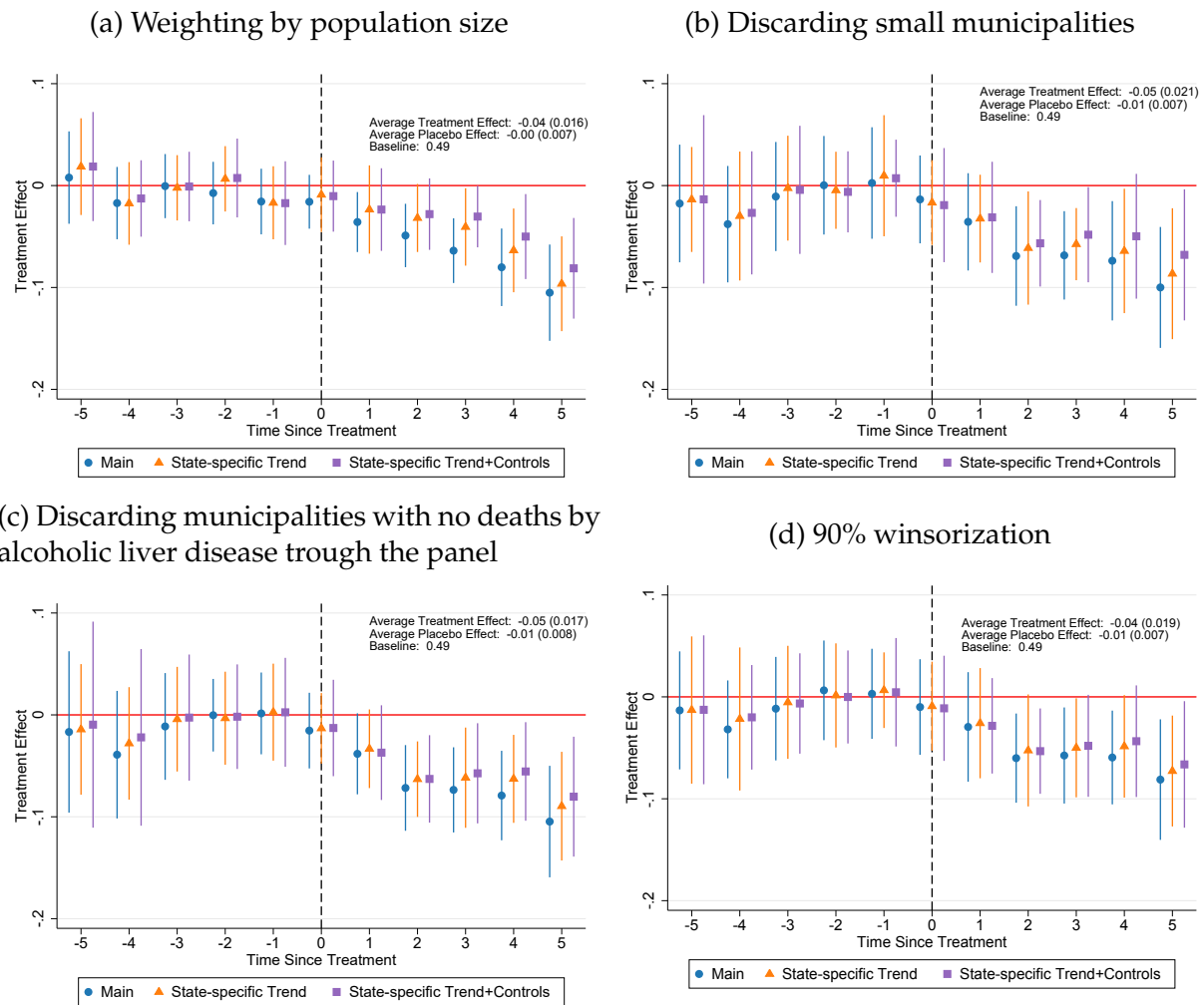

(d) 90% winsorization

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the CAPS' effects on the rate of deaths caused by alcoholic liver disease (code K70), for different specifications. In panel a, we present estimates weighted by the baseline population size; in panel b, we discard municipalities bellow the 10th percentile of the population size distribution; in panel c, we restrict the sample to municipalities reporting positive counts of deaths by alcoholic liver disease in all years; and in panel d, we set data below the 5th percentile to the 5th percentile, and set data above the 95th percentile to the 95th percentile. Regarding covariates, the same specifications from Figure 3 also apply here. The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

Figure A.14: Effects of CAPS on placebo outcomes – 02-16

(a) Municipality GDP per capita

Average Treatment Effect: 0.00 (0.004)
Average Placebo Effect: 0.00 (0.001)
Baseline: 2.65

(b) PBF speding per capita

Average Treatment Effect: -0.01 (0.008)
Average Placebo Effect: -0.00 (0.002)
Baseline: 4.40

(c) Infant mortality

Average Treatment Effect: 1.55 (2.792)
Average Placebo Effect: 0.01 (1.007)
Baseline: 173.41

(d) Deaths due to vaccine-preventable diseases and infectious diseases

Average Treatment Effect: -0.06 (0.067)
Average Placebo Effect: -0.07 (0.024)
Baseline: 8.14

(e) Deaths due to car accidents

Average Treatment Effect: 0.02 (0.029)
Average Placebo Effect: -0.03 (0.008)
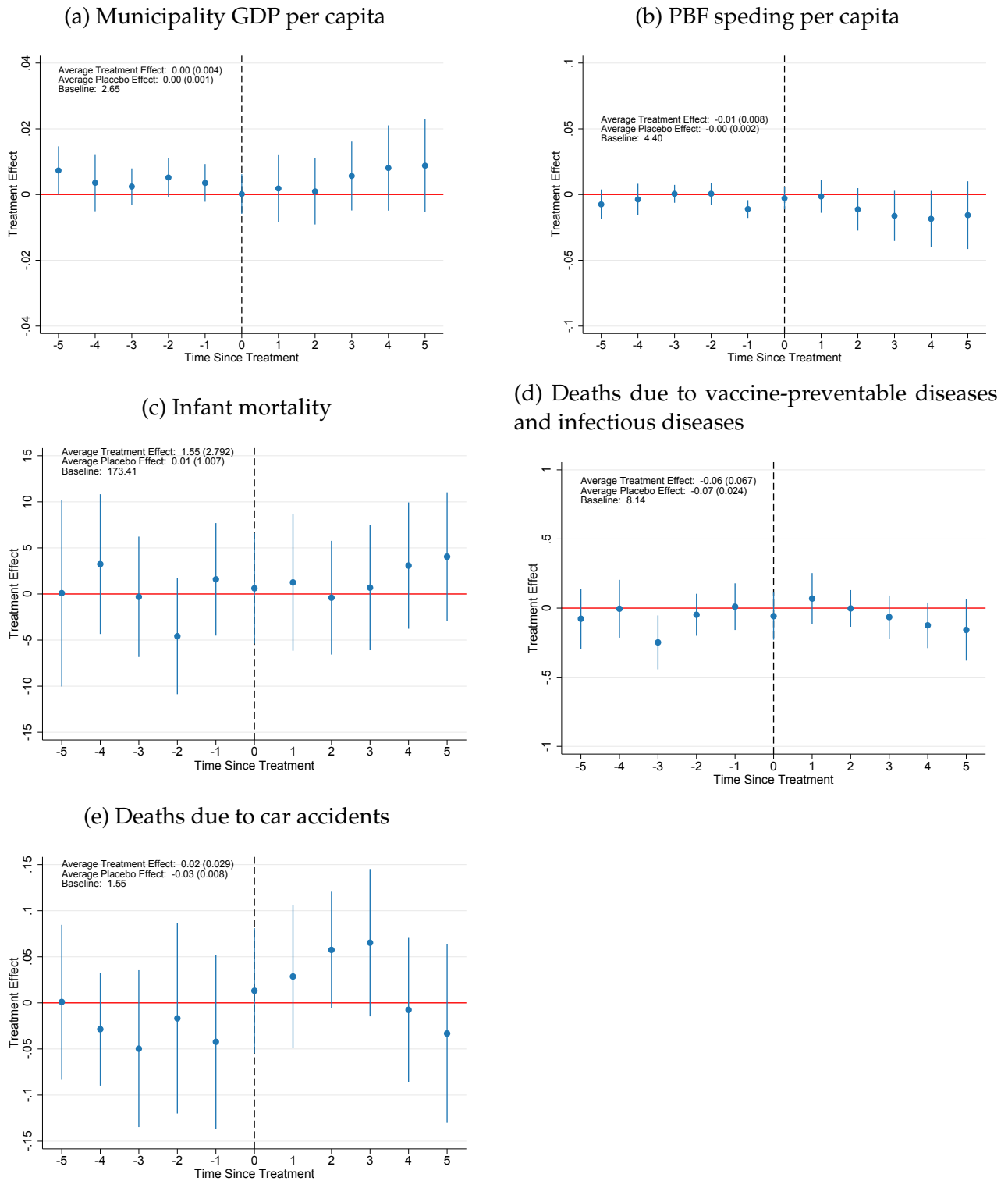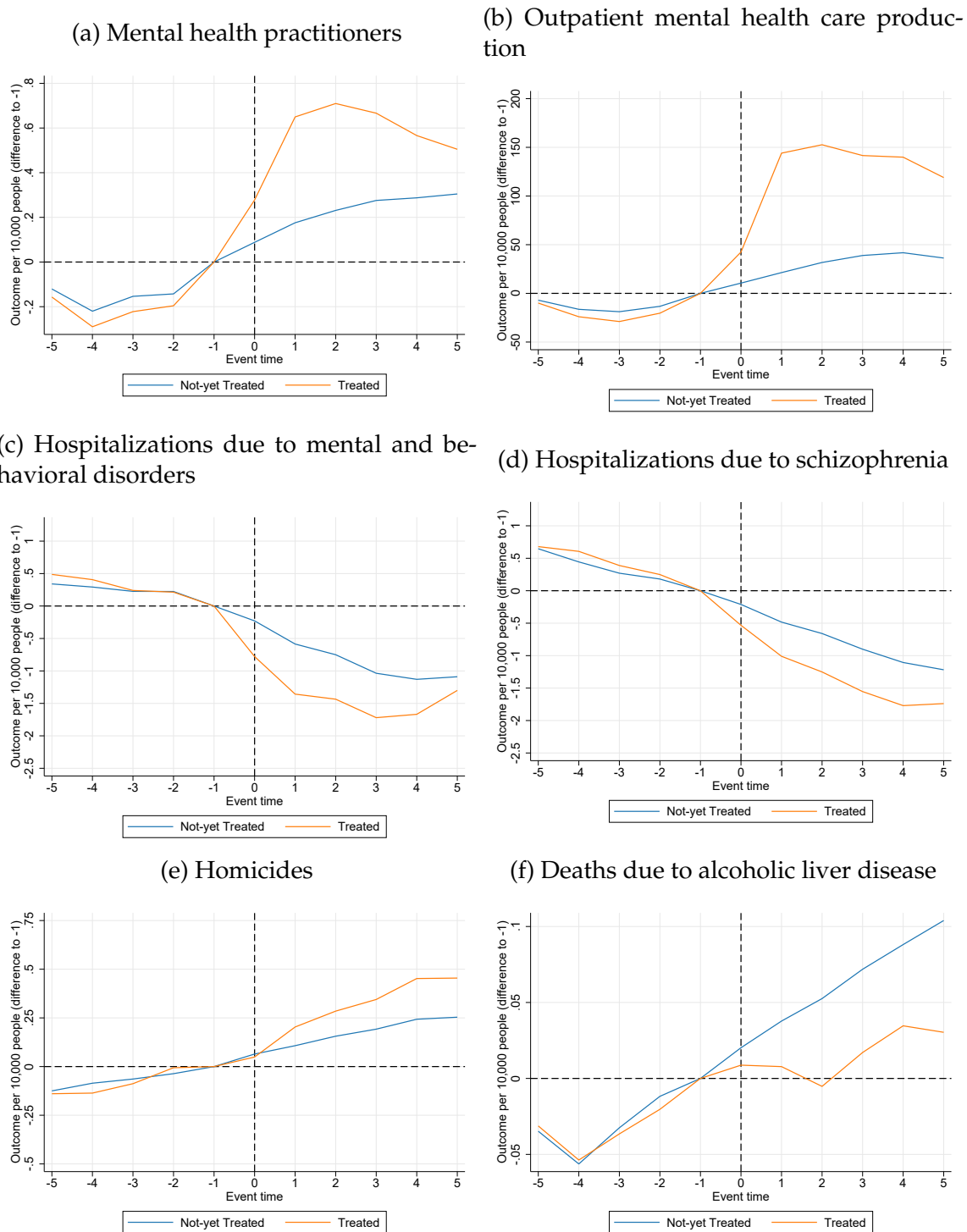Baseline: 1.55

Notes: This figure plots 95% confidence-intervals computed with a municipality-level clustered bootstrap and dynamic and placebo DID estimators for the effects of CAPS on municipality GDP per capita (panel a) and PBF spending per capita (panel b), infant mortality (panel b), deaths due to vaccine-preventable diseases and infectious diseases (panel d), and deaths due to car accidents (panel e). The Average Treatment Effect compute a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls. In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period.

Figure A.15: Trends of our main outcomes for the treated and not-yet treated cities across the event times

(a) Mental health practitioners

(b) Outpatient mental health care production

(c) Hospitalizations due to mental and behavioral disorders

(d) Hospitalizations due to schizophrenia

(e) Homicides

(f) Deaths due to alcoholic liver disease

Notes: These figures aggregate data on our primary outcomes across the event times after we stack data for each treated cohort and its respective control group. We plot residualized (state×year fixed effects) time-series, evaluated relative to the event-time -1. When aggregating data, we follow De Chaisemartin and d'Haultfoeuille (2020) and use a weighted average based on the size of each treated cohort. We also follow the authors when choosing the control group (not-yet treated), which includes the cities that will never be treated and those that will be eventually treated in more distant event-times. Panel (a) plots the rate of psychiatrists, psychologists, occupational therapists, and social worker per 10,000 people. Given the previous results suggesting that the supply of mental health practitioners increases one year before the treatment (Figure 3), we define –for this outcome, in particular– the event-time 0 as the period immediately before the year CAPS starts functioning. Panel (b) plots the rate of outpatient procedures delivered by a mental health practitioner. Panel (c) plots the rate of hospital admissions due to mental and behavioral disorders (ICD-10, F00-F99). Panel (d) plots the rate of hospital admissions due to schizophrenia and related disorders (F20-F29). Panel (e) plots homicide rates. Panel (f) plots death rates due to alcoholic liver disease (K70) and exploits only variation from CAPS AD.

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Table A1: Descriptive Statistics – baseline year (2002, except where noted)

	All	Treated	Never Treated
Hospitalizations (per 10,000 pop.)			
Mental and behavioral disorders	14.89	13.90	14.89
Schizophrenia	6.59	6.46	6.54
Mood Disorders	1.70	1.50	1.73
Stress-related disorders	0.10	0.12	0.09
Psychoactive substance abuse	4.79	4.31	4.82
Mental retardation	0.22	0.21	0.20
Dementia	0.19	0.21	0.18
Others	1.29	1.10	1.32
Mortality (per 10,000 pop.)			
Suicide	0.56	0.45	0.60
Overdose	0.01	0.01	0.01
Alcoholic and chronic liver diseases	0.74	0.77	0.70
Mental and behavioral disorders	0.40	0.39	0.40
Homicide	1.29	1.70	1.06
Outpatient Care (per 10,000 pop.)			
By psychiatrists (2008)	30.84	45.44	28.47
By psychologists (2008)	77.56	67.05	79.27
By social workers (2008)	29.03	23.38	29.95
By occupational therapists (2008)	19.85	18.78	20.03
Antipsychotic drugs	0.77	0.55	0.16
Mental Health Facilities (per 10,000 pop.)			
Psychiatrists (2006)	0.21	0.30	0.14
Psychologists (2006)	0.86	0.65	0.89
Social workers (2006)	0.59	0.47	0.60
Occupational therapists (2006)	0.11	0.14	0.07
Psychiatric beds (2006)	0.85	1.57	0.28

To be continued

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	All	Treated	Never Treated
Municipalities' Characteristics			
Number of municipalities	5180	1344	3836
Population	31007	43884	9437
Men	0.51	0.50	0.51
Age 10–19	0.19	0.20	0.19
Age 40–49	0.12	0.12	0.12
Age 70–79	0.04	0.03	0.04
PBF per capita	4.02	4.08	4.05
GDP per capita	2.26	2.28	2.22

Notes: All tabulations refer to the baseline year (2002), except where noted. Treated includes the cohorts of municipalities that implemented a CAPS for the first time in the period 2003-2016. Men, Age 10–19, Age 40–49, and Age 70–79 represent the fraction of the population that are men, and the fraction within each age bin (10-19, 40-49, and 70-79).

Table A2: Groups of Mortality and Morbidity Causes and Associated ICD-10 Codes

Group	ICD-10 Codes
Mental and behavioral disorders	**F00-F09**: Organic, including symptomatic, mental disorders **F10-F19**: Mental and behavioral disorders due to psychoactive substance abuse **F20-F29**: Schizophrenia, schizotypal and delusional disorders **F30-F39**: Mood disorders, including major depressive disorder and bipolar disorder **F40-F48**: Neurotic, stress-related and somatoform disorders **F50-F59**: Behavioral syndromes associated with physiological disturbances and physical factors **F60-F69**: Disorders of adult personality and behavior **F70-F79**: Mental retardation **F80-F89**: Disorders of psychological development **F90-F98**: Behavioral and emotional disorders with onset usually occuring in childhood and adolescence **F99**: Unspecified mental disorder
Homicide	**X85-Y09**: Assault, excluding injuries due to legal intervention and operations of war
Deaths of Despair	**X40-X45, Y10-Y15, Y45, Y47, Y49**: Alcoholic poisoning and overdose of prescription and illegal drugs **X60-X84**: Suicide **K70**: Alcoholic liver disease **K73, K74**: Unspecified chronic liver disease

Table A3: Hazard estimation of probability of receiving a CAPS (marginal effects)

	(1)	(2)	(3)
A. Lagged variables (per 10,000 people)			
Δ_{-1}Hosp: Mental & Behavioral Disorders	0.00008		
	(0.00008)		
Δ_{-1}Deaths: Mental & Behavioral Disorders	-0.00006		
	(0.00051)		
Δ_{-1}Deaths of Despair	0.00015		
	(0.00042)		
Δ_{-1}Homicides	-0.00008		
	(0.00034)		
Δ_{-1}arcsinh(GDP per capita)	0.00143		
	(0.00457)		
Δ_{-2}Hosp: Mental & Behavioral Disorders		-0.00002	
		(0.00009)	
Δ_{-2}Deaths: Mental & Behavioral Disorders		0.00034	
		(0.00054)	
Δ_{-2}Deaths of Despair		-0.00023	
		(0.00045)	
Δ_{-2}Homicides		0.00036	
		(0.00036)	
Δ_{-2}arcsinh(GDP per capita)		0.00315	
		(0.00486)	
Δ_{-3}Hosp: Mental & Behavioral Disorders			-0.00009
			(0.00009)
Δ_{-3}Deaths: Mental & Behavioral Disorders			0.00000
			(0.00053)
Δ_{-3}Deaths of Despair			-0.00005
			(0.00044)
Δ_{-3}Homicides			0.00025
			(0.00036)
Δ_{-3}arcsinh(GDP per capita)			0.00598
			(0.00475)
B. Variables at baseline			
Theil Index (2000)	0.06141	0.06020	0.04973

	(1)	(2)	(3)
	(0.00562)	(0.00601)	(0.00610)
Share Illiterate (2000)	-0.02865	-0.02497	-0.01717
	(0.01405)	(0.01479)	(0.01483)
Share Poor (2000)	-0.04439	-0.04626	-0.03486
	(0.00892)	(0.00941)	(0.00928)
Share Rural (2000)	-0.06102	-0.05955	-0.05721
	(0.00445)	(0.00467)	(0.00477)
Hosp: Mental & Behavioral Disorders (2003)	0.00005	0.00005	0.00002
	(0.00004)	(0.00005)	(0.00005)
Deaths: Mental & Behavioral Disorders (2003)	-0.00006	-0.00008	-0.00018
	(0.00086)	(0.00090)	(0.00089)
Deaths of Despair (2003)	0.00074	0.00081	0.00093
	(0.00063)	(0.00066)	(0.00064)
Homicides (2003)	0.00241	0.00249	0.00204
	(0.00037)	(0.00040)	(0.00040)
arcsinh(GDP per capita) (2003)	-0.00044	-0.00097	0.00021
	(0.00139)	(0.00150)	(0.00149)
Observations	53,096	48,045	43,089
State FE	Yes	Yes	Yes
Time Polynomial Degree	5	5	5

Notes: Marginal effects of the hazard estimation of probability of receiving a CAPS. In this sample, covering the period from 2003 to 2016, units appear in the data until they receive a CAPS and, after that, they leave the sample. Each specification considers a different lagged difference of the main variables of interest and control for their baseline values, as well as the baseline values of other variables of interest as indicated in the table. A logit model is estimated and the reported marginal effects are taken at the average of each variable. Observations at the municipality level.

Table A4: Average treatment effect of CAPS on our main outcomes

| | Outpatient Care | | Hospitalization | | | Mortality | |
	Procedures	Antipsychotic Drugs	Overall	Schizophrenia	Long-stay	Alcohol	Homicides
a. Selected Sample							
Average Effect	247.11	15.40	-0.94	-0.78	-0.79	-0.09	0.13
s.e.	(16.82)	(5.28)	(0.28)	(0.17)	(0.16)	(0.04)	(0.04)
Baseline	198.50	11.61	13.80	6.17	6.82	1.03	1.85
N	63849.00	63849.00	223669.00	223602.00	188573.00	282145.00	223669.00
N switchers	1456.00	1456.00	5370.00	5370.00	5218.00	1074.00	5370.00
b. Full Sample							
Average Effect	206.26	9.36	-0.72	-0.60	-0.62	-0.07	0.12
s.e.	(14.12)	(4.58)	(0.24)	(0.13)	(0.13)	(0.04)	(0.04)
Baseline	250.75	9.17	12.66	5.36	6.01	1.06	1.94
N	108372.00	108372.00	305095.00	304993.00	257031.00	364687.00	305095.00
N switchers	2305.00	2305.00	6789.00	6789.00	6508.00	1401.00	6789.00

Note: This table reports the average treatment effect of CAPS introduction on the rate of outpatient procedures delivered by a mental health practitioner (Procedures), dispensed antipsychotic drugs (Antipsychotic Drugs), hospital admissions due to mental and behavioral disorders (Overall), hospital admissions due to schizophrenia (Schizophrenia), long-stay (longer then one month) admissions due to mental and behavioral disorder (Long-stay), deaths due to alcoholic liver disease (Alcohol), and homicides (Homicides). The Average Treatment Effect computes a weighted average of the dynamic estimators, giving to each estimator a weight proportional to the number of switchers the estimator applies to, considering the specification with state-specific trends and controls (See Figure 3). In parenthesis, standard errors computed with a municipality-level clustered bootstrap. Baseline indicates the sample mean values for the treated in the pre-CAPS period. In panel a, we restrict the sample to units with a CAPS in operation for at least five years. In panel b, we use the full sample.